Welding Engineer

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AUGUST, 1958

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Vol. 43 — No. 8

Welding Engineer

The magazine of joining and severing materials

This is welding: August, 1958

Brazing

The **processes** . . . the **joint designs** . . . the **fluxes** . . . the **alloys.** Each of these factors contribute heavily to brazing success. WE brings you a concise rundown on each, beginning on page 30

Filler Metals for joining 35

Orville T. Barnett continues his series with a discussion of brazing alloy properties in this 16th article.

Welding Engineering 39

▶ ▶ ▶ ▶ ▶ ▶ ▶ Chapter I of WE's newest series by Editor and Publisher **T. B. Jefferson** covers the history and recent developments in arc, gas and resistance welding. The impetus of two wars on welding's progress is described, as are the areas in which welding is now used.

Selection, welding of CrMo alloy steel pipe 42

Jay Bland of Standard Oil Co. (Ind.) concludes a two-part series with this discussion on effects of preheat and postheat treatments on the weld properties of chrome-moly steel pipe.

Introduction to welding: a course for cadets 48

Peter G. Poetto reports on the introduction, avid acceptance and further preparation of a pre-welding engineering course at an east coast military academy.

Cars will soon cross new aluminum bridge 54

Three aluminum producers join with the Iowa Highway Commission to demonstrate aluminum's structural and fabrication advantages in a wholly new area.

Honeycomb gets new brazing method 62

▶ ▶ ▶ ▶ ▶ ▶ ▶ **Robert B. Stanton** details Convair's struggle to find a brazing method which would be effective on silver-manganese sheet alloy used in the fabrication of today's supersonic jet planes.

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Easier living . . . through welding 58
Hobart opens new school 68

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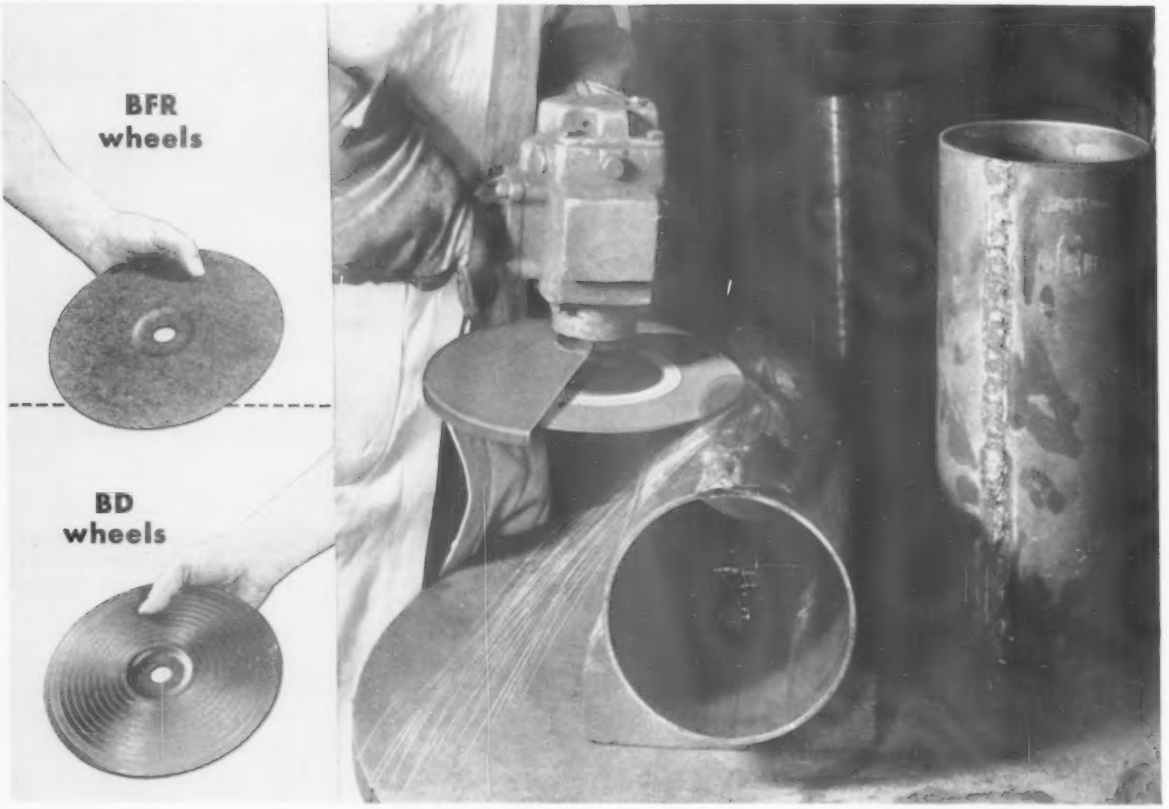

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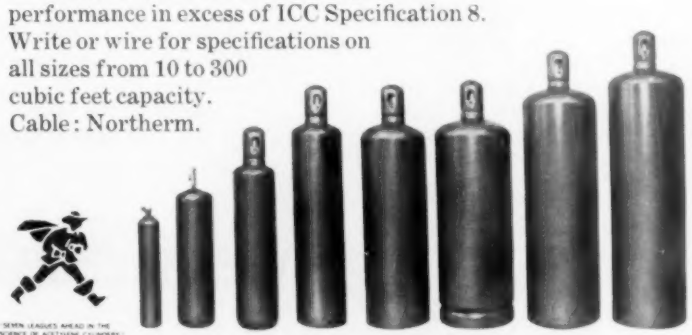

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NEWS

NEMA arc welding section holds quarterly meeting

Highlights of reports given at the recent quarterly meeting of The National Electrical Manufacturers Association's arc welding section follow:

—Color markings for new electrodes in the iron-powder and low-hydrogen iron powder fields have been prepared, reported the color markings and standards committee. The new markings will be released simultaneously with the American Welding Society approval announcement.

—The committee on military and federal specifications covering arc welding electrodes and filler wire is working on a project to assure one common denominator for all military specifications that will be standard and applicable to all branches of the service.

—The section voted to print 5,000 copies of the revised NEMA Arc Welding Manual and distribute them to colleges and universities.

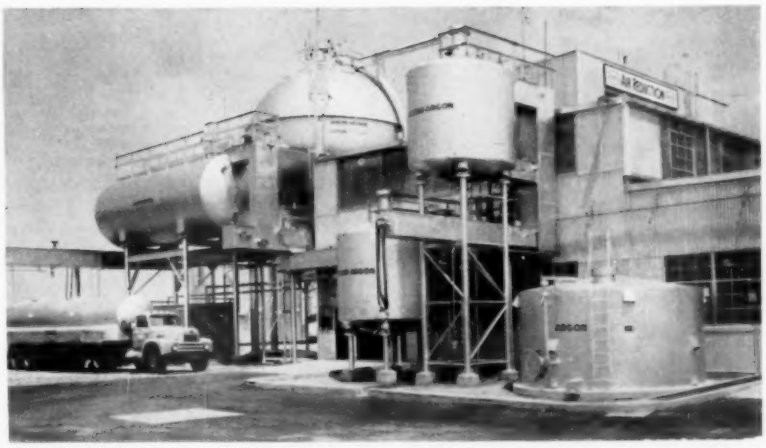
—A program is being completed whereby more consideration would be given to deposited weld metal chemistry in the selection and specification of an electrode. It will be presented to the AWS Technical Council by a section committee in the future.

In other business L. Berg was appointed associate and voting representative, with J. Humberstone continuing as executive representative of Air Reduction Sales Co. Quarterly meetings for the section were set for the following dates and places: Sept. 18, Cleveland; Dec. 4, Chicago; March 12, Pittsburgh; June 4-5, 1959, Hot Springs, Va.

Ampco expands in Canada, France

Ampco Metals, Inc., Milwaukee, Wisc., has licensed the Canadian Bronze Co., Montreal, to pour Ampco metal and distribute the firm's raw material products. The licensing will enable Ampco to supply the Canadian market with sand and centrifugal castings, extruded products, die blanks and centrifugally cast bars.

A licensee arrangement between Ampco and the Sarazin and Cie Co. of France has been approved by the French government. The license calls for the exclusive manufacture in France of covered electrodes, filler rod and spooled wire to be sold under Ampco trade names.



AIR REDUCTION'S new liquid oxygen, nitrogen and argon plant at South Acton, Mass.

Air Reduction opens South Acton plant

Air Reduction Sales Co., New York City, has opened a new plant for the production of liquid oxygen, nitrogen and argon in South Acton, near Boston. The new plant, the first of its kind built in New England, will produce 75 tons of the liquefied gas daily. The gases will be used in the electronics industry to weld external transistor parts, in fabricating and cutting processesses in ship-building, and in the fabrication of various parts for jet aircraft.

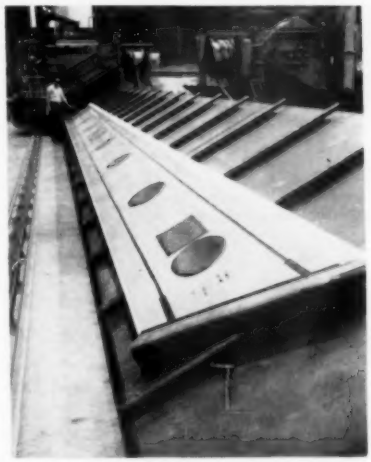
O'Grady elected president of welding alloy group

J. A. O'Grady was unanimously elected president of the Resistance Welding Alloy Association at the group's second annual meeting recently held in Detroit. O'Grady was vice president of RWAA since its organization in 1956, and is president of Weldaloy Products Co., Van Dyke, Mich.

President of the S-M-S Corp., Detroit, J. C. Cox, was elected vice president of RWAA. Cox also serves on the executive committee of the Detroit section of the AWS.

Liquid Carbonic opens liquid-oxygen plants

Liquid Carbonic Div. of General Dynamics Corp., Chicago, formally opens three new liquid-oxygen plants this month with Frank Pace, Jr., president of General Dynamics, officiating at the openings. The plants are located in Urbana, Ohio; Oakland, Calif.; and Toronto, Ont. Also scheduled for opening is a new CO_2 plant at St. Paul, Minn., and a new electrolytic plant at San Carlos, Calif.



BOEING Airplane Co., Wichita, uses shot peening equipment for both stress relieving and contouring parts for the B-52 global bomber. The unit used has a worktable track 96 ft long and can handle material as large as 76 ft long and six ft wide. Machine operates at 25 psi, but twice this pressure is available.

Lincoln names "Weldealer of year"

The R. V. May Co., Prestonburg, Ky., won the annual Lincoln Electric Co. "Weldealer of the year" award, based on "achievements in performance, cooperation, development, and leadership." Lincoln stressed the importance of planned promotions that May carried out. The promtions included county fair and on-the-job demonstrations and welding clinics.

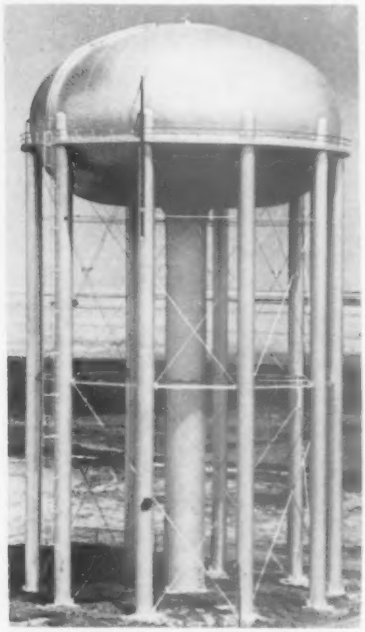
Crucible combines technical functions

Research on metals, development and metallurgy will be handled in a new combined technological department at Crucible Steel Co. of America, Pittsburgh, Pa.

RYERSON spark testing demonstration. See story at right.

Ryerson open house draws 800 visitors

Dinner, tours and demonstrations entertained 800 visitors at the Joseph T. Ryerson and Son, Inc., Charlotte N. C., open house. Demonstrations included steel flame-cutting and cutting with heat generated by friction. A tour of the steel service plant included a visit to the year-old warehouse and office building.



DESIGNED by Chicago Bridge and Iron Co., Chicago, this 1,000,000-gal spheroidal elevated tank was built for the Pampa, Texas, municipal water system. The tank is 75 ft in diameter, 100 ft to bottom, has a 35-ft range and a 10-ft diameter central riser. Tubular supporting columns are 4-ft in diameter.

Welding advances on European feeder

Welding progresses at the rate of 2,300 to 2,625 ft a day on the first section of the biggest feeder in Europe. The line will carry gas refined at the Lacq natural gas field in southwest France to the underground reservoir at Lussagnet, near Bayonne. The 23.6 in. diameter pipe will be able to support 147.4 lb of pressure per 0.1549 sq in. When the pipe is completed another one, with a carrying capacity of 211,896,000 cu ft of gas daily, will be stretched several hundred miles toward Angouleme and Nantes.

Tank-in-box car developed by Linde

Linde Co. has developed a tank-in-box railroad car for the transportation of liquefied atmospheric gases. The company is offering a license package that includes all working drawings necessary for construction, use of Linde's patents covering construction, and necessary engineering assistance.

The car has powder-in-vacuum insulation, and an oxygen capacity of the liquid equivalent of 1,000,000 cu ft NTP. Gas losses are small, even when the liquid is held in the tank for long periods. Maintenance records show that the average annual repair bills are less than 1/100 of the initial car cost.

AWS to present third Davis Award

A new annual award for the best paper on maintenance and hardfacing has been announced by the American Welding Society. The award will be the third made possible by its donor, A. F. Davis, vice president and secretary of The Lincoln Electric Co., Cleveland.

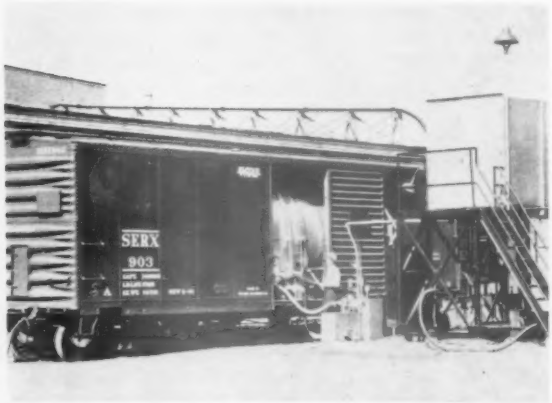
A silver medal and certificate will be given to the author of the paper selected by the AWS committee on awards as the best published in the *Welding Journal* on maintenance and hardfacing. To qualify, the paper must be written by one or two authors and published during the calendar year. The first award period covers 1958.

The new award, along with those previously established by Davis, will be presented at the AWS convention in April, 1959, at Chicago.

Welding courses offered by Stevens Institute

Stevens Institute of Technology, Hoboken, N. J., will offer three course in metallurgy during the 1958-59 academic year. The courses, "Properties of metals," "Metal joining, light assemblies," "Metal joining, heavy assemblies," will be open to high school graduates with a knowledge of arithmetic and elementary algebra, or those who have equivalent experience in industry. The "properties" course is a pre-requisite

(Continued on page 84)



LINDE Co.'s tank-in-box car for cryogenic fluids has an oxygen capacity of the liquid equivalent of 1,000,000 cu ft NTP.

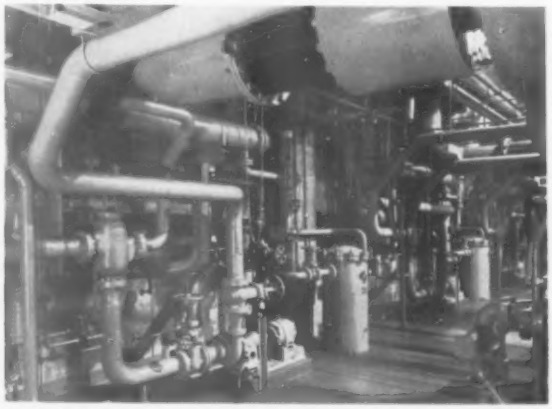


PHOTO of welded piping done by Natkin & Co. in power house in Kansas City, won L. Jones second prize in photographers meet.

The ambulances of Bowers Ambulance Service, of Long Beach, California, are the products of experts. . . .

Among the finest ambulances made in America are those of the Bowers Ambulance Service of Long Beach, California. From Cadillac Chassis to National Oxygen Regulator, no effort has been spared to select only tested, reliable, dependable equipment. When life hangs in the balance no mechanical trouble must have the slightest chance to tilt the scales against the patient.

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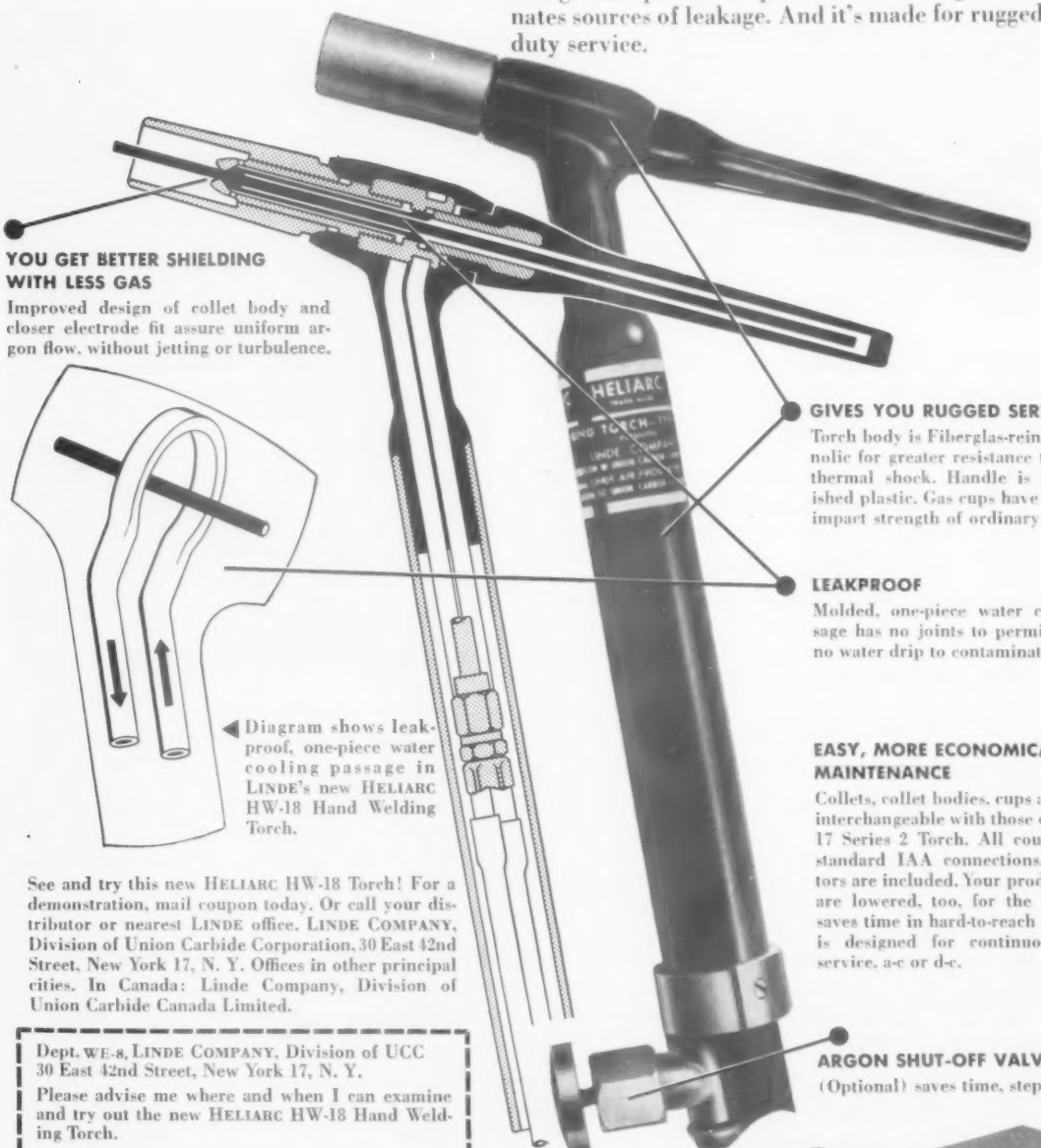

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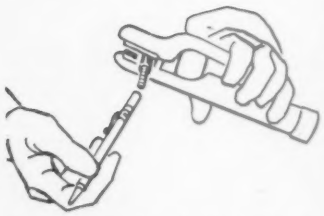
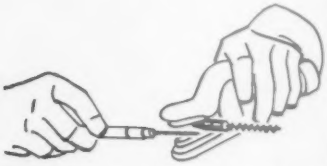


Insert tapered end of brush to hold jaws open. Pull handle away.



Reverse broach in handle. Clean contact surfaces and sides of jaws.

Now cock jaws open with tapered end of broach and use brush for final polishing.

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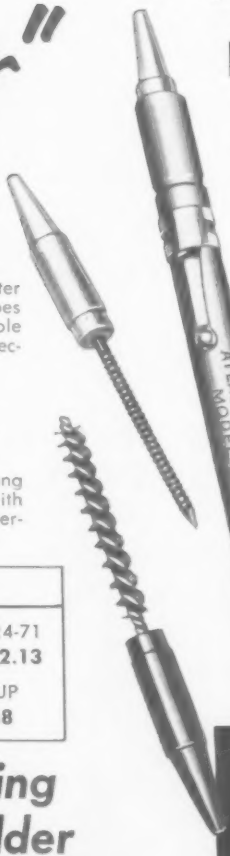

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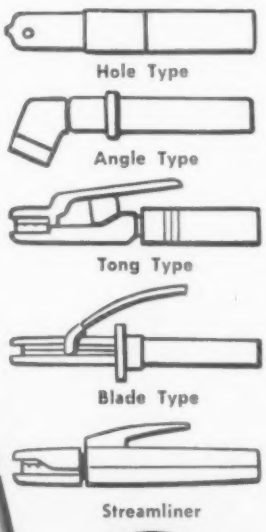

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AUGUST
1958

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Weld World

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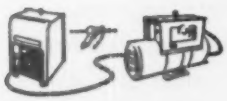


. . Helium may be produced in large quantities, if Bell Lab's new process is developed commercially. High-purity helium is obtained from natural gas by diffusion through capillary tubes.

. . Aluminum cylinders for LP gases are in offing. Benson Mfg. Co., Kansas City, Mo., says a 100-lb capacity tank will take 900 psi, weighs about 30% less than most bottles used for gas. Aluminum cylinders are used in Europe for oxygen, acetylene, and LP.

. . Pressure bonding process for joining aluminum to stainless steel was introduced last month by Toastmaster Div., McGraw-Edison Co., and Alcoa. Shown in new electric frying pan, method, according to Alcoa engineers, offers possible uses of aluminum in combination with carbon and alloy steels, copper, other aluminum alloys.

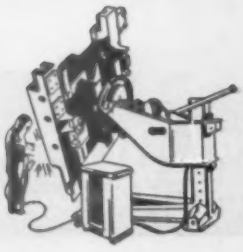
. . Depleted uranium is now available for sale on unclassified basis. Atomic Energy Commission has removed prohibitions on non-nuclear uses. Industrial applications include its use in ceramics and glass products, especially as coloring agent, and in photographic film.

. . At this writing steel prices had not gone up. In fact, one scheduled increase (by Alan Wood Steel Co.) was canceled because big producers did not go along. Hike will probably still come, but not until demand begins to pick up.

. . International Nickel Co. of Canada is cutting nickel production 20%—its third reduction of year. Reason: "big inventories in Inco's hands and in hands of U. S. government."

. . Aluminum producers were still undecided about raising prices as we went to press. Wage hikes went into effect Aug. 1. Last price adjustment on aluminum was downward—pig prices were cut 2 cents to 24 cents per pound April 1.

. . A process of forming metal into intricate shapes by use of explosives has been developed by missile firm. Method is said to be also capable of embossing, inlaying joining. Taking cue from wartime underwater blasts, engineers conducted experiments with metals placed around basic work forms at bottom of water tank. Shock waves put to work by dynamite duplicated nearly every operation of drop hammer, press, brake, etc. Process evolution could mean production ideal for aircraft and missiles which would be made in "two pieces and glued down the middle."



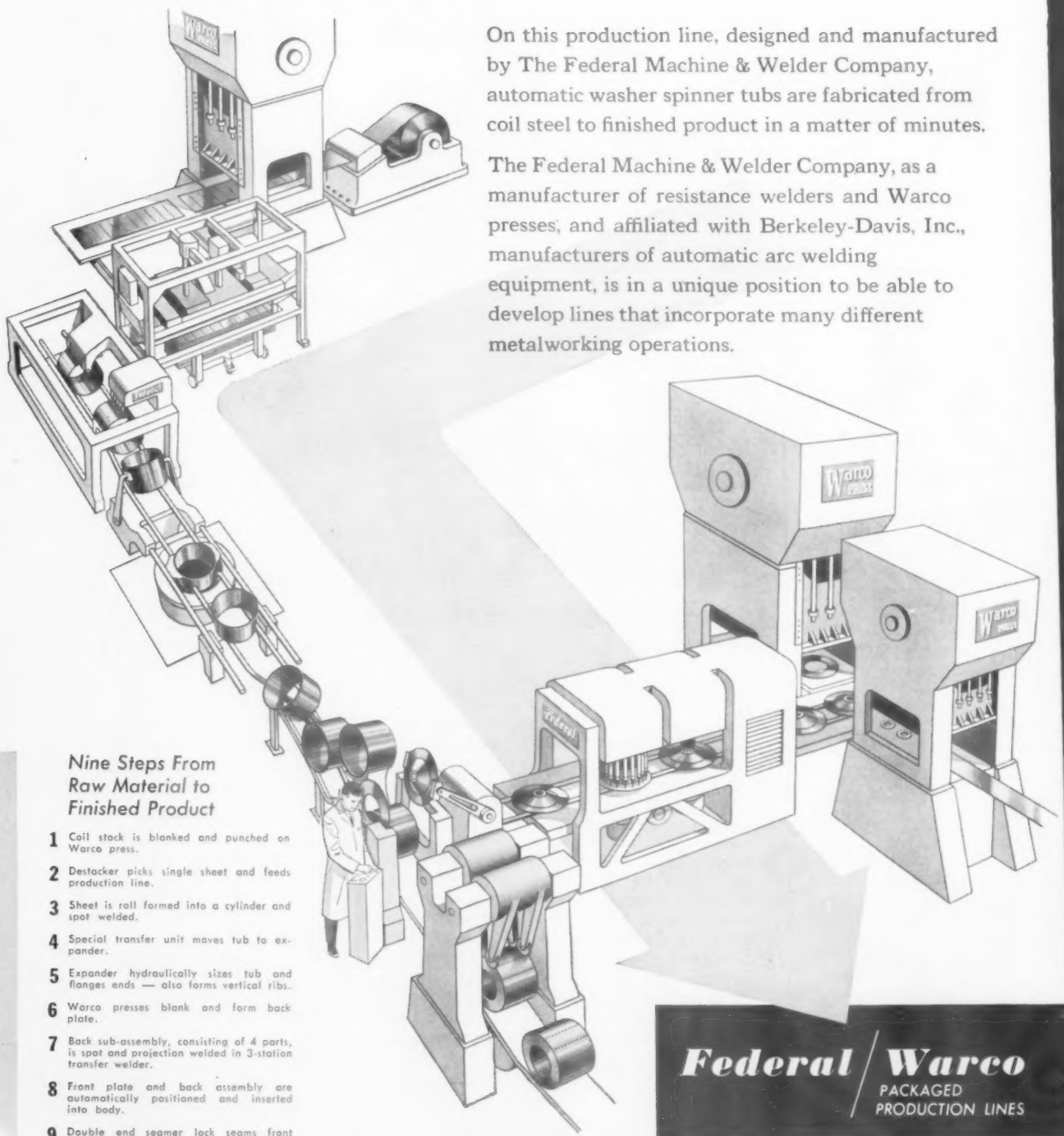
. . Adhesive bonding and plastic welding, having been recognized by AWS as within its scope, are eligible for exhibition at 1959 welding show, to be held in Chicago. Firms and personnel in these fields also become eligible for AWS membership.

THE ACCENT IS ON PRODUCTION

in a production line by FEDERAL

On this production line, designed and manufactured by The Federal Machine & Welder Company, automatic washer spinner tubs are fabricated from coil steel to finished product in a matter of minutes.

The Federal Machine & Welder Company, as a manufacturer of resistance welders and Warco presses, and affiliated with Berkeley-Davis, Inc., manufacturers of automatic arc welding equipment, is in a unique position to be able to develop lines that incorporate many different metalworking operations.



Nine Steps From Raw Material to Finished Product

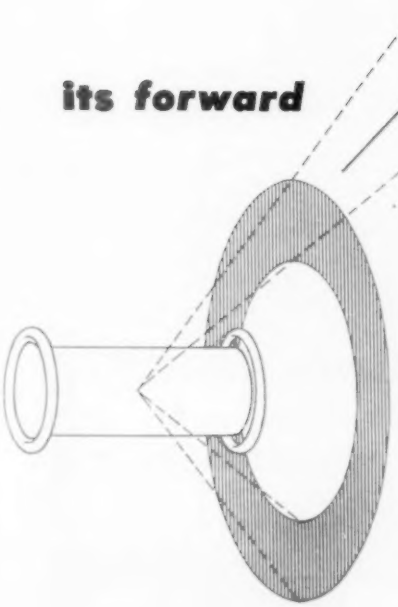
1. Coil stock is blanked and punched on Warco press.
2. Destacker picks single sheet and feeds production line.
3. Sheet is roll formed into a cylinder and spot welded.
4. Special transfer unit moves tub to expander.
5. Expander hydraulically sizes tub and flanges ends — also forms vertical ribs.
6. Warco presses blank and form back plate.
7. Back sub-assembly, consisting of 4 parts, is spot and projection welded in 3-station transfer welder.
8. Front plate and back assembly are automatically positioned and inserted into body.
9. Double end seamer lock seams front plate and back assembly to body and ejects finished tub.

* Sequence of operations controlled by static relay system designed and built by Federal.

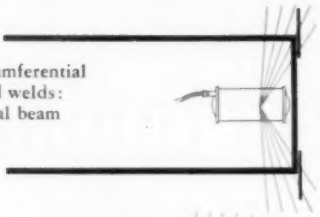
Federal / Warco
PACKAGED PRODUCTION LINES

THE FEDERAL MACHINE AND WELDER COMPANY, WARREN, OHIO
Affiliated with Berkeley-Davis, Inc., Danville, Illinois

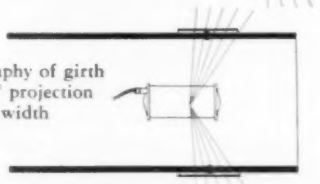
its *forward* *throw* 360° radial x-ray beam makes light work of tough radiographic jobs like these



Inside-out one shot circumferential radiography of tank-head welds: the forward-thrown radial beam gets the whole corner.



Circumferential radiography of girth welds: the wide-band 30° projection x-rays the full seam with width to spare on either side.



Despite the power it packs, the tubehead is light enough for one man to handle.

Easy setup for simultaneous panoramic radiography.

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NEW

ANDREX FT360

160 KV portable x-ray unit

Easy to position anywhere . . . here it is being lowered for "one-shot" radiography of a massive girth weld.

lightweight
one man can easily carry its 72 lb. tubehead

compact
can enter a 9" diameter opening

powerful
full 160 KV takes 2" steel, 5" aluminum in stride

selfcontained
complete weatherproof "package"—no shockproof cables or water lines

economical
an investment that will pay manifold dividends for years for a modest outlay of **$5400**

Call any Picker branch office (see local 'phone book) or write Picker X-Ray Corporation, 25 South Broadway, White Plains, N. Y.

Picker x-ray

one stop for everything in industrial radiography

ANDREX	portable x-ray units—130 KV, 160 KV, 200 KV, 260 KV
PICKER	x-ray units—5 to 50 KV, 150 KV (stationary and mobile), 270 KV portable, 260 KV heavy-duty
TECH/OPS	units for isotope radiography—sources, equipment, containers for Iridium ^{192} Cobalt ^{60} and Thulium ^{170}
ACCESSORIES	. . . films, tanks, darkroom sundries, illuminators, everything

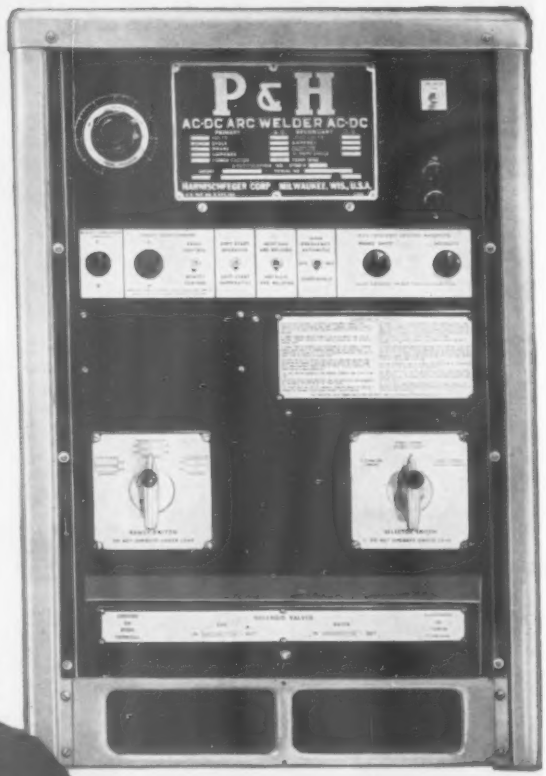
Stop burn through... eliminate craters!

New P&H welders provide

exact heat, perfect timing

for inert gas welding

Built-in high-frequency, gas, water, and spot-gun controls enable you to weld materials as thin as .005 inches without burn-through or craters! The new P&H welders give you P&H "Dial-lectric" control for fast micro-heat adjustment at the machine or by remote control. "Soft-start" device eliminates blasting — phase-shift and intensity rheostats speed arc-starting and stabilize arc intensity over each entire range, eliminate chopping. And for inert gas welding at its best, you can have P&H wave balance built into your machine at extra cost. Write for bulletin "HF Welders," Dept. 317B, Harnischfeger Corp., Milwaukee 46, Wisconsin.



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HF-GW WELDER SHOWN

3 Types—9 Models
Change from metallic-arc
to inert gas welding
with the flip of a switch

P&H AC High-frequency WELDERS:
4 sizes, 7 to 670 amps.

P&H DC High-frequency WELDERS:
2 sizes, 3 to 550 amps.

P&H AC-DC
High-frequency WELDERS:
3 sizes, 5 to 670 amps.

Remember September

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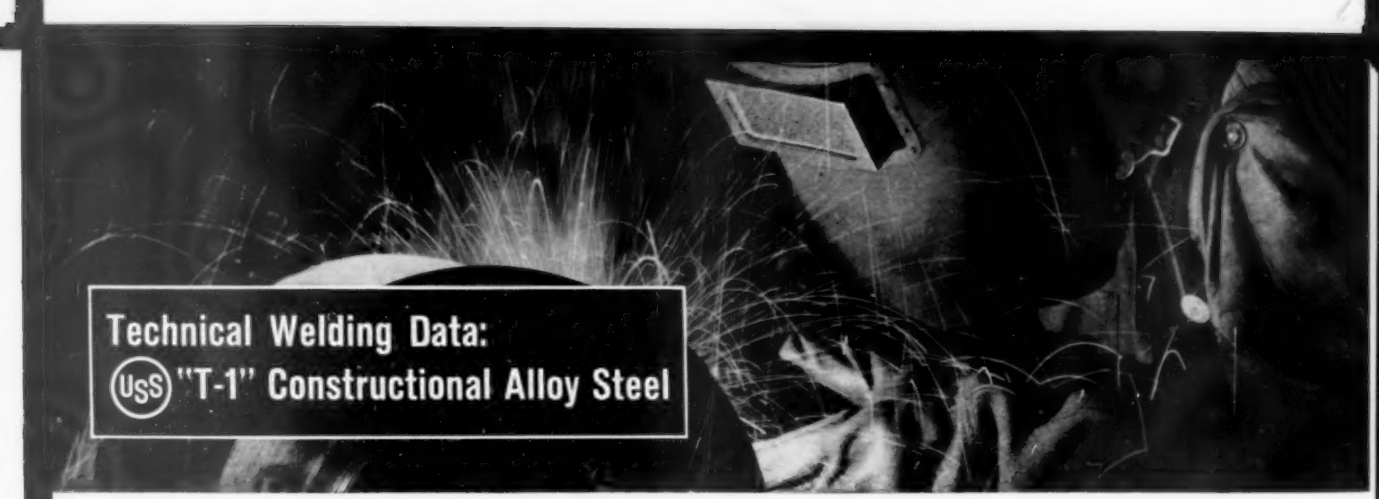


Technical Welding Data: USS "T-1" Constructional Alloy Steel

3. Effect of welding on notch toughness

THE EFFECT OF WELDING on the notch toughness of steel is normally determined by Kinzel-type notch-bend tests on welded and unwelded plate in the quenched and tempered condition. Details of the welded plate specimen are shown in Figure 1. The unwelded specimens are identical to the welded, except for the omission of the weld. The plate temperature prior to welding is 70° F., and after welding, the specimens are aged at 50-80° F. for a minimum of three weeks. The specimens in sets of about 25 are then bent at various temperatures with the weld bead in tension as shown in Figure 1. In general, three specimens are tested at each temperature.

INFORMATION DETERMINED FOR EACH SPECIMEN TESTED

1. Total (maximum) angle of bend and angle of bend at maximum load. Obtained from deflection-angle curve.
2. Fracture mode expressed as per cent shear. Obtained by observation of fracture.

The data obtained are plotted on the basis of testing temperature, and envelopes are drawn around the plotted points to indicate the amount of scatter. The curves for ½"-thick USS "T-1" Steel plate welded with E-12015 electrodes are shown in Figure 2. The data are for specimens taken longitudinal to the final rolling direction of the plate.

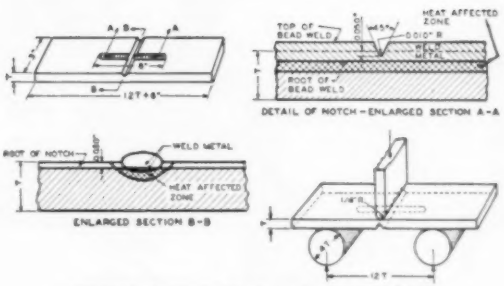
TO DETERMINE DUCTILITY-TRANSITION TEMPERATURES, the middle of the temperature range in which the total angle of bend drops rapidly to a low value is chosen. This is the temperature at the middle of the "scatter band" in the angle of bend curve in Figure 2.

THE FRACTURE-APPEARANCE-TRANSITION TEMPERATURE is also determined. As used here it is the temperature at which 50% of the fracture occurs in the shear mode, i.e., 50% of the fracture is fibrous. Typical curves are shown in Figure 2.

The results of notch-toughness studies on ½"-thick plate are given in the Summary, at right. The Summary includes data for Regular Quality plate as well as data for Firebox Quality plate.

It should always be borne in mind that at the present time there is no absolute correlation between transition temperature as obtained experimentally with the various types of specimen and service performances. *Results obtained from the same types of tests on different steels should be very useful in establishing the relative merit of the steels.*

REMEMBER THIS: No other alloy steel offers the combination of properties that "T-1" Steel possesses. Here, in just one steel, you get very high yield strength (100,000 psi minimum), extraordinary toughness, great resistance to impact abrasion, and good high temperature strength. These let you reduce the size of highly stressed parts . . . save weight, reduce the amount of welding required and cut your costs.



WELDING CONDITIONS: electrode diameter 3/16"; current (amps) 180; voltage 27; speed of travel (in./min.) 6.0; heat input (watt sec./in.) 48,000.

Fig. 1. Details of Kinzel-type notch-bend specimen and of testing jig.

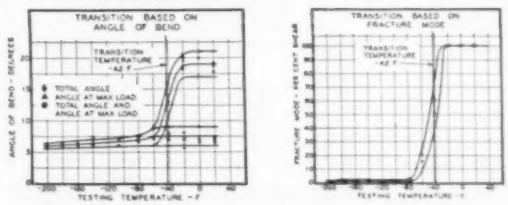

TRANSITION BASED ON ANGLE OF BEND
TRANSITION TEMPERATURE -62 F
TOTAL ANGLE
ANGLE AT MAX LOAD
TOTAL ANGLE AND ANGLE AT MAX LOAD
ANGLE OF BEND - DEGREES
TESTING TEMPERATURE - F
TRANSITION BASED ON FRACTURE MODE
TRANSITION TEMPERATURE -62 F
TESTING TEMPERATURE - F

Fig. 2. Measurements and transition-temperature selection criteria in Kinzel-type notch-bend test.

Summary of notch-toughness test data on ½" USS "T-1" Steel plate (heat No. 74L236)

Test	Type of Plate	Specimen Orientation	Specimen Condition	Ductility-Transition temp., °F.*	Fracture-Appearance-Transition temp., °F.**
Kinzel notch-bend	Firebox Quality	Long.	Unwelded	minus 68	minus 67
Kinzel notch-bend	Firebox Quality	Trans.	Unwelded	minus 62	minus 59
Kinzel notch-bend	Regular Quality	Long.	Unwelded	minus 130	minus 128
Kinzel notch-bend	Regular Quality	Trans.	Unwelded	minus 91	minus 91
Kinzel notch-bend	Firebox Quality	Long.	Welded†	minus 42	minus 42
Kinzel notch-bend	Firebox Quality	Trans.	Welded†	minus 50	minus 47
Kinzel notch-bend	Regular Quality	Long.	Welded†	minus 92	minus 89
Kinzel notch-bend	Regular Quality	Trans.	Welded†	minus 112	minus 112
Kinzel notch-bend	Firebox Quality	Long.	Welded and stress-relieved‡	minus 30	minus 27

* *Taken at middle of bend*
** *Selected at 50% shear*
† *E12015 electrodes*
‡ *E9015 electrodes; Stress-relieved at 1100°F. for 1 hr.*

USS "T-1" Steel is being used in bridges, excavating equipment, pressure vessels, towers . . . in equipment that must take heavy abuse in sub-freezing temperatures . . . in equipment that must withstand heavy stresses and impact abrasion at temperatures as high as 900° F.

FOR COMPLETE INFORMATION about the application and fabrication of USS "T-1" Steel, write for our new comprehensive booklet to United States Steel, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
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Crushing 60,000 lbs. per week
of glass-sharp, extremely abrasive material is the job of these hammermill hammers. No wonder they become rounded and worn, lose cutting efficiency, require regular build-up.

HARDFACING WITH AMSCO 20

doubles service life . . . cuts electrode costs

Welding Flux Processing, Chicago Heights, Illinois, know a good thing when they see one. That's why they've switched *exclusively* to Amsco 20 electrodes for hardfacing of these hammers. They're saving three ways:

1. Service life of the built-up hammers and the mill housing itself has been doubled, because of Amsco 20's high abrasion resistance.
2. Amsco 20 electrodes cost about 40% less than the type previously used.
3. Welding speed is stepped up. Amsco 20, an iron powder "contact" electrode, is easy to handle and gives a high deposition rate.

In this and many other severely abrasive applications, Amsco 20 has *proved* its ability to provide superior wear resistance at low cost. Available from stock in 3/16" diameter, to handle hardfacing jobs of almost any size.

Call your nearby Amsco Welding Distributor now, for a demonstration of Amsco 20. Or write direct for technical data to: Amsco Welding Department, Chicago Heights, Illinois.

AMERICAN Brake Shoe COMPANY

AMSCO®

American Manganese Steel Division · Chicago Heights, Ill.

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Letters . . .

Letters should be addressed to: The Editor, WELDING ENGINEER, P. O. Box 28, Morton Grove, Ill. No letter will be published unless signed, but your name will be withheld if requested.

Used but not abused

Sir: *Reading, Pa.*

In reference to your article on America's oldest torches, (June, 1958; p. 54) you may be interested in two that I use daily in my shop. They are both Oxweld type W1. One has been in use since 1918 and the other since 1920. I use them for all types of welding, such as pipe castings, etc.

I have three other torches that date back to that time from which I take spare parts. I have a variety of old and new tips that I keep and often use. My father, who founded the business, used them and passed them on to me, and they are still good after 20 years service . . .

I read your magazine with great interest as it has most of the new articles on welding there are. I am also a teacher of welding in night school, and often show my pupils the new processes in your magazine. Thanks for all the new ideas, I hope to see more in the future.

Norman Hunsicker

Sir: *Seattle*

I read your magazine all the time and sure find a lot of good stuff in it. I liked that story about the feller who works for the bridge company in Chicago, and has an old welding torch.

We have a feller here who has an axe that once belonged to George Washington. It's so old it has had three new heads and five new handles. Been used every day, too. Guess that should beat that bridge buildin' feller.

Ben Zickefoose

Certified or not?

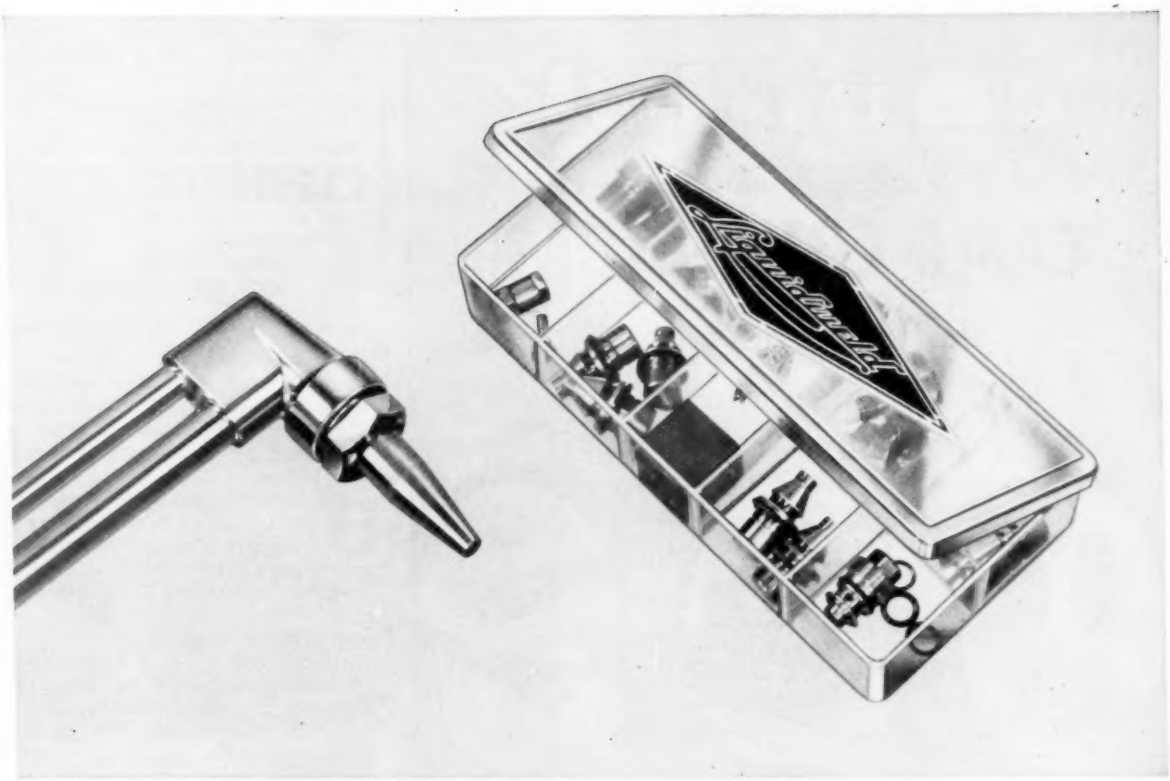
Sir: *Santa Monica, Calif.*

I am writing regarding the article published in the June *Welding Engineer* by W. R. Stevens, entitled "What is a certified weldor?"

Is Mr. Stevens aware that there are welding tests given other than the ASME Building and Pressure Vessel Code, Section 9? For instance, the American Bureau of Shipping, United States Navy and American Welding Society are giving tests to weldors.

I have before me a card issued by the city of Los Angeles, Board and Safety Commission which states in very bold lines across the face of the card "approved certified arc weldor".

I heartily agree with Mr. Stevens that the ASME card is more of a test on pro-



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provide **"Do-It-Yourself" repairability** on the job

Down-time is reduced and operating delays cut to a minimum when you use Liquidweld.

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"Do-It-Yourself" kits of replacement assemblies are now available for both Liquidweld welding and cutting torches.

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Company_____ Title_____

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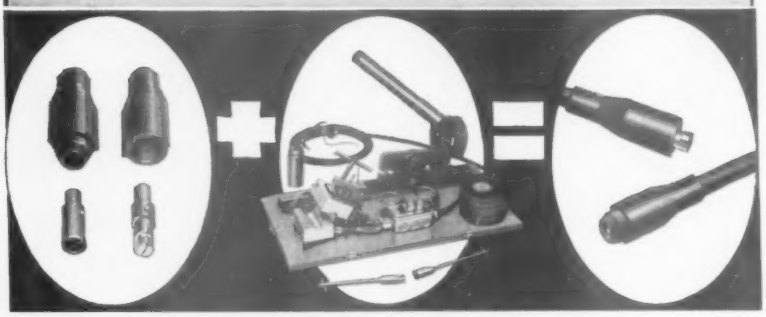
City_____ Zone____ State_____

cam-lok

neoprene insulated

CABLE CONNECTORS

. . . the smoothest connection you can make!



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No more bulky cable connections to "foul up" on obstructions and delay production. Now you can make shockproof, waterproof cable connections in your own plant in minutes with a 110 volt portable Vulcanizing Kit. Seals prefabricated neoprene insulating sleeves to cable jackets . . . cable breakage at connector is eliminated . . . cable jackets cannot pull away. Connectors lock tight—stay tight! Join all cable sizes instantly without adaptors.

The Cam-Lok Vulcanizing Kit can also be used with an adaptor mold to make neoprene insulated, waterproof *Cable Splices!*

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cedure than it is on weldors, however, if the operator is not a good weldor and does not know his heats, arc rod, oscillation, etc., he will not pass the test.

I do not believe it was Mr. Steven's intention to take away from the dignity of a weldor; however, if a man is able to pass the test and prove his ability I can see nothing wrong with the title "certified weldor".

James P. O'Neill
Santa Monica City College

Sir: *Chillicothe, Ohio*

The article by W. R. Stevens entitled "Who is a certified weldor?" (June, p. 70) was thought-provoking and questionable. The second sentence in the second paragraph appears to be contradictory.

The sentence states, "The weldor is not certified, but manufacturers and contractors certify he is able to do a specific job according to stipulated procedures." He says first ". . . weldor is not certified . . ." then he says ". . . contractors certify he is able . . ."

It seems to me that a weldor who satisfactorily completes the accepted procedure and performance qualifications tests in accordance with applicable specifications should be distinguished from the weldor who has not satisfactorily completed the same tests. If a manufacturer or contractor were to certify that all procedures and weldors were tested according to particular requirements or specifications, it appears justifiable to use the . . . word "certified" . . . to describe a weldor. After a weldor's work or ability has been endorsed authoritatively, which means the same thing as having his work certified, it is believed he should have a title to indicate just that.

Certified weldors? Yes, there are many such persons!

W. B. Keyser

Improper application

Sir: *Cleveland*

In looking through the May 1958 issue of WELDING ENGINEER, we ran across a picture of a grinding wheel being used on a very rough off hand operation without the benefit of a guard.

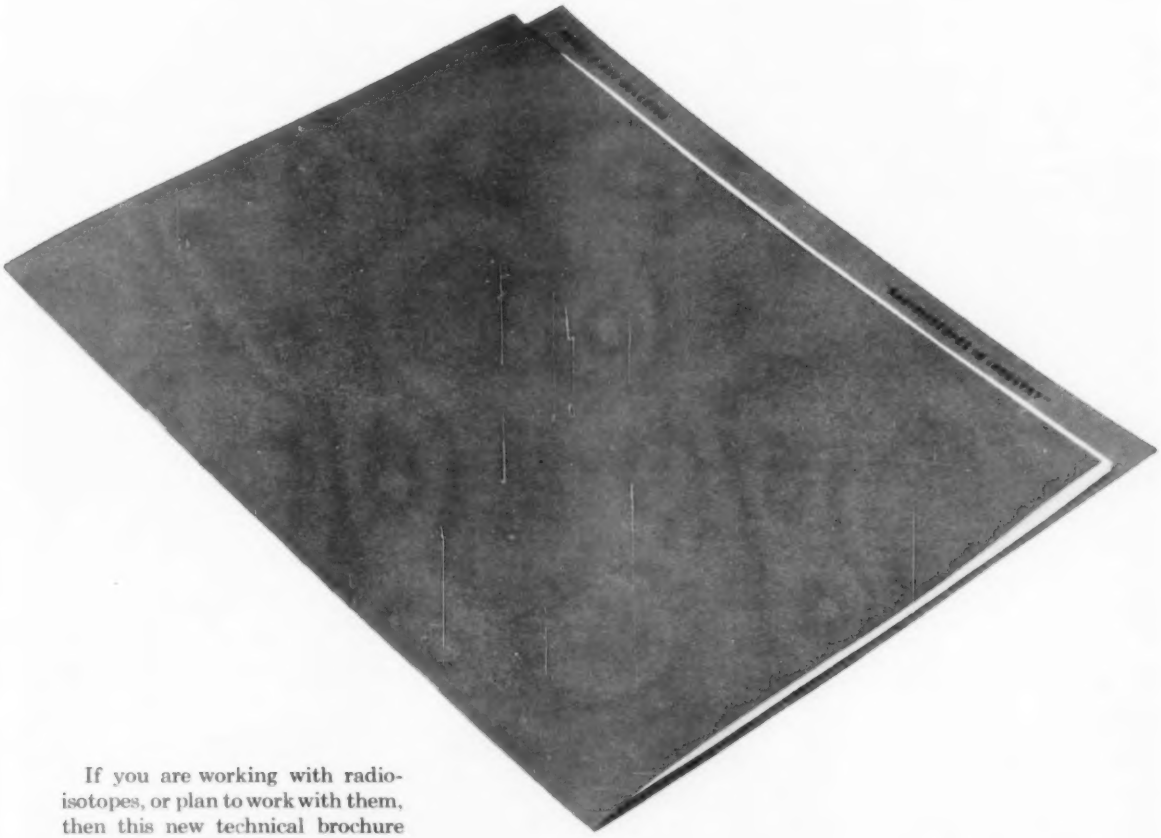
We realize that perhaps the guard was removed from the machine for illustrative purposes; however, this is not indicated anywhere under the photo. Needless to say this grinding wheel application is extremely hazardous. It might be well to call this improper grinding wheel application to the attention of the manufacturer who has the equipment in use.

Allen P. Wherry
Grinding Wheel Institute

COBALT 60, CESIUM 137, IRIDIUM 192 . . .

the whole story in a nutshell in Ansco's free new

"RADIOISOTOPES IN INDUSTRY"



If you are working with radioisotopes, or plan to work with them, then this new technical brochure is a must for your files.

It gives needed facts and figures on the use of major radioisotopes . . . explains in detail half-lifes, intensity, energy . . . and, describes how each of these characteristics affect exposure time and radiographic quality. It also presents basic exposure factors and compares the quality of radiographs made by exposure to x-rays and gamma rays.

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Industrial X-ray

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Gentlemen: Please send me a copy of "Radioisotopes In Industry". I am actively engaged in industrial X-ray work.

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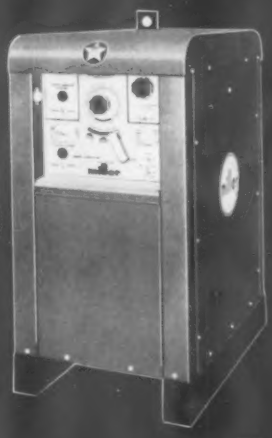
SR . . . the dc rectifier type welder with new completely sealed semimetallic rectifier, new transformer and new weld stabilized circuit. Result is easiest arc starting ever; maximum arc stability; sounder, denser welds; current that handles all electrodes in all positions! Four models, 200 to 600 amps.

SRH . . . the same revolutionary improvements that set the Gold Star SR above and beyond the performance standards ever before achieved by a dc rectifier type welder. Designed primarily for compactness, the SRH is only 30¼" high — is ideally suited for stacking or paralleling in minimum space. Three models, 200 to 400 amps.

The miller GOLD STAR ALL STAR LINE

300 . . . combination ac, dc welder design comes of age with this new Miller model. Features: new magnetic amplifier circuit; improved wave form; new arc starting control; three electrically controlled current ranges for finest adjustment; instant change-over from ac to dc; built-in high frequency. An entirely fresh concept for inert gas and metallic welding. Four basic models with kits available to convert to seven different types of welders.



300-M . . . an ac welder for inert gas and metallic arc processes. Combines unequalled welding characteristics with Miller's unique electric control circuit which permits precise slow or fast start. Features: built-in high frequency, primary contactor and ½ KVA control transformer. Offered in three basic models of from 200 to 400 amperes with optional water and gas controls available.

Complete particulars on any of the above welders will be sent promptly.

miller ELECTRIC MANUFACTURING COMPANY, INC. Appleton, Wisconsin

Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal, P. Q.

BETWEEN PASSES

curtain wall

Good looks and speed of construction—these are important advantages of the newest trend in architecture: the curtain wall. The wall usually is a thin, lightweight sheet of stainless steel, or aluminum, and glass. *And more often than not, the metal is welded. WE* only recently published a feature article on this type of construction (see "Aluminum curtain wall 'clothes' Manhattan building," June, p. 52). So here is another addition to the already staggering list of welded products that make for more comfortable living.

Remember September!

hi-temp standards

Standard samples of high-temperature alloys are being prepared by the National Bureau of Standards at request of the Navy Bureau of Aeronautics and Wright Development Center. Standards for both spectrometric and chemical analyses will cover composition ranges of 17 commercial types of such alloys. Research is also underway on new and improved methods of analysis to insure accurate analysis of the standards and optimum conditions for their application in other laboratories. The Bureau now distributes over 550 samples of chemicals, metals, and other materials to laboratories for use in instrument calibration and process control. But recent advances in jet aircraft, rockets and guided missiles have brought about a need for additional standard samples to aid in controlling composition of alloys able to withstand high temperatures encountered in such applications.

safety "roll"

Helping promote plant safety and other important campaigns at Tube Turns are unique rolling bulletin boards. The Louisville, Ky., plant of the Chemetron Corp. division has borrowed an idea from ad-bedecked buses and has posters plastered on backs of motor-driven dollies. "The posters are changed regularly and since the dollies pass any given point in the plant many times daily, space in the new advertising medium is already at a premium," according to S. Jack Gardner, Tube Turns' safety director.

"matched irons"

The petroleum refining industry has become the first user of Lukens Steel Co.'s newly introduced line of electrodes which match the firm's line of plates. Union Boiler and Mfg. Co., Lebanon, Pa., has ordered Plate-Mate 8018-B2 electrodes for use with chromium-molybdenum alloy steel plate to be used for critical welds in catalytic cracker cyclones.

circuitous solder

A magnifying glass is one of the tools included in a repair kit for printed circuits. Motorola, Inc., Chicago, markets the new kit, which also has nippers, solder, miniature soldering iron, brushes, protective fluid, and solvent.

memories

An 11-year-old WELDING ENGINEER editorial cropped up in a recent brochure published by the Canadian Welding Bureau, Toronto. The 16-page, two-color booklet entitled "The First 10 years," depicted the progress of welding (especially structural) in Canada since formation of the Bureau 10 years ago. Title of the *WE* editorial written by T. B. Jefferson was "Too many cooks." It cited establishment of the Bureau as an example the welding industry in the U. S. could well emulate. A division of Canadian Standards Association, the Bureau administers national welding codes, thus avoiding the multiplicity of standards with which other Canadian industries (and most U. S. industries, including welding) were and are plagued.

daffynitions

To an English stenographer who only recently began working in the welding industry, some of the technical terms are distinctly ambiguous. Our correspondent, who now works in Canada and wishes to remain anonymous, sent along these alternate descriptions:

Pressure reducing regulators—for those who find dieting too strenuous.

Dipper teeth—the ones in the bedside glass.

Grouser bars—where you have a drink while you grumble.

Grizzly bars—where alcoholic bears go.

Control panel—film censorship board.

Soapstone holders—display racks for Eskimo art.

the Bard

Shop condition: Everything's OK at radiographic inspection

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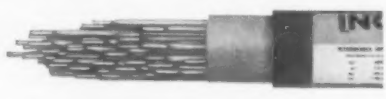

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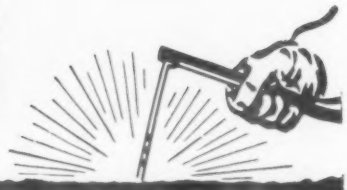

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AUGUST, 1958

Welding Engineer

ESTABLISHED 1916

Stand and be counted

THE MONTH that WELDING ENGINEER has been writing about is almost here. We've asked you to "Remember September—National Welded Products Month". We hope you have—and that you will continue to do so.

There was something in the nature of a challenge prompting this public-education campaign. We want our readers to stand and be counted . . . to place themselves squarely behind all that's good and valuable in our industry and give it new impetus.

There are altogether too many people nowadays who talk big until the time comes for action. They may then be found in a dark corner with their hands deep in their pockets. It happens in industry, and in the community when the time comes to plan urban improvements.

It is also a common occurrence when our big government does something that displeases us. Do we take a stand and debate the issue with congressmen . . . or do we use the privilege of a secret ballot to rectify previous elective errors? Some of us do—*but most of us don't!*

We don't want to see apathy in any area, and particularly in the welding field. "Remember September" was a part of our editorial contribution aimed at sparking continuing interest in our bread-and-butter industry. But passive remembrance of welding's economy, simplicity, speed and appearance was not our principal campaign objective.

IN TERMS that leave no room for misinterpretation, we have suggested on this page that "National Welded Products Month" become a byword for all of us in welding—whether on the job or in conversations with neighbors and friends.

You may wonder what value a mention of welding could have for a friend unconnected with the industry. We maintain that it would have the same value as a reference to the fact that every citizen's share of the national debt is $1587.00 . . . or that Congressman Jones hasn't once voted in favor of worthwhile legislation during his past term in office.

Your friend won't turn white with shock or red with anger. He may not even offer a comment in return. But you will have planted a seed in his mind that will remain there, ready to grow and take the shape of an opinion whenever the subject of the national debt or Congressman Jones—or *welding*—is again discussed.

THE SAME HOLDS TRUE in a job situation. But here you will encounter persons who have a definite connection with welding . . . persons who probably have formed definite opinions, pro or con, about this metal-joining method.

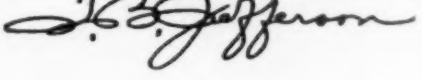
If, in the course of welding sales or service work, you encounter a purchasing agent or engineer with decidedly negative views, what should you do to give welding a "foot in the door"? Should you avoid an argument? *By all means.* But don't avoid a statement of any facts that would favor welding's use!

It sounds fairly simple—this stating of facts—but it isn't. Initially, you will never become acquainted with a single welding fact unless you are eager enough to go looking for them. Secondly, you won't develop an eager spirit until welding means more to you than any other job you might hold.

Does welding have that much meaning for you at present? If it does, you have an intimate understanding of our own enthusiasm for this young and remarkable field.

But if welding isn't more than just 40 hours of weekly labor to you, now is the time to discover just what's lacking in your attitude toward an industry that can provide success and prosperity for you until retirement.

Remember September!



To prepare new crushers for a hard life, Wasco County, Oregon, hardfaces rollers with Victor alloy rod. The rollers showed no discernible wear after crushing 3100 tons of extremely hard and abrasive basalt.

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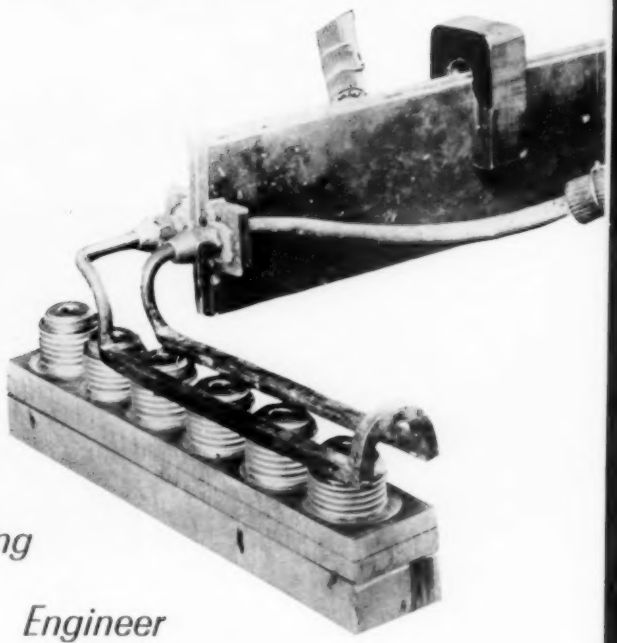


Welding Engineer

presents

Brazing

Remarkably chipper for its age—an estimated 2,800 years, and probably more—brazing is today embarked upon a vastly successful "second childhood."

Sparking this progress in recent years had been the continuing development of more and better alloys, more potent fluxes, and the introduction of machines which have brought brazing processes to the fore in high-production situations.

But behind these technological advances lies the elemental reason for brazing's popularity: *ease of application.*

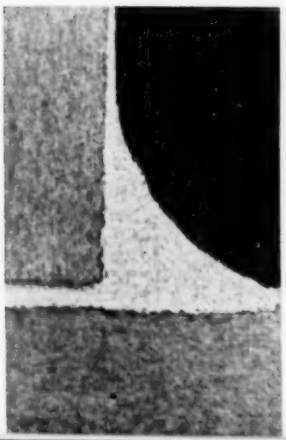
In all cases, brazing alloys flow *before* the melting temperature of a base metal has been reached. And to this notable advantage can be added those of:

1—strength . . . a brazing alloy is far stronger than a solder and, sometimes, almost as strong as a weld;

2—economy . . . when strength is not a highly critical factor, and where complex joints are encountered, brazing is usually less costly than arc or resistance welding;

3—application variety . . . the user is afforded a choice of several processes in applying brazing alloys.

Brazing, in short, is one of the important metal-joining processes of today and tomorrow. And on the following pages are the brazing design, equipment, alloy and material facts you'll want to know and keep.



the processes

—*Handy & Harman*

Extreme left:
dip brazing (salt bath).

Left:
torch brazing with face-fed alloy.

—4 have commercial importance today

ALTHOUGH THE AWS master chart of welding processes lists eight methods for the application of brazing alloys, only four possess commercial importance today.

The total group includes the torch, induction, furnace, dip, resistance, twin-carbon arc, block and flow processes. Of these, the torch method is by far the most popular. Induction and furnace brazing methods have made great strides in recent years, and dip brazing with either a chemical or molten metal bath is extensively used.

Flow brazing, because it entails extravagant alloy use and a heavy post-braze cleaning job, is rapidly being replaced by more economical methods. Use of the twin-carbon arc torch for brazing is also on the downgrade, mainly because the carbon-arc torch itself is disappearing from the welding scene.

The resistance brazing method has lost headway in the past decade as faster processes (*e.g.*, furnace and induction) gained industry acceptance. The localized heating that characterizes resistance brazing obviously does not lend itself to the rapid handling of lengthy seams or complex parts.

Block brazing—the use of metal blocks preheated to an exact temperature and clamped on either side of parts to be brazed—is a slow and tedious process marked by the continuing need to remove the blocks for reheating. (A modification of this old process, however, offers greater flexibility and faster brazing speeds. For details on its operation, see *New process features close control of brazing heat* in the June issue of WELDING ENGINEER, p. 38.)

Here are salient features of the four processes most important to U.S. industry today:

Torch brazing. This process is generally a manual one, but torches can also be set up in a manner that permits them to be moved past a line of parts to be brazed—or to handle a number of parts carried through the torch flames.

Tips used for torch brazing can be the welding type with a single orifice, or they may be larger in diameter with several orifices to permit a more general flame distribution. Bar-type nozzles 6 or 8 in. long can also be used.

Though the oxyacetylene mixture is the most popular choice, a variety of gases can be employed in torch brazing. Among these are the oxy-hydrogen, oxypropane, oxygen or air and city gas, and compressed air and city gas mixtures. Regulator pressures for torch brazing are generally similar to those used in welding, but the flame must be made softer to prevent the blowing effect that could ruin a brazed joint.

Also required for torch brazing is a slightly reducing (excess-acetylene) flame which helps the operator avoid any possibility of joint oxidation or of overheating base metal. Contrary to gas welding practice, the operator does not touch the inner cone of the flame to the alloy or joint; only the flame envelope is used for heating.

Induction brazing. The absorption of heat energy by parts placed in close proximity to an a-c coil characterizes induction brazing. The parts being brazed in this manner are *not* a part of the electrical circuit.

The user of induction brazing may employ a vacuum tube, motor generator or spark gap unit to provide necessary electrical power. Current of the highest frequency (200,000 to 5,000,000 cycles) is produced by a vacuum-tube oscillator. The spark gap unit develops current in the 20,000 to 300,000-cycle range. Currents of up to 10,000 cycles are provided by motor generator sets.

Relatively low frequency current obtained from a motor generator naturally leads to deeper heating of a workpiece. The current characteristic of this unit also forces the user to place coils extremely close to a workpiece . . . and to use only those currents in the highest frequency range provided by the unit. The fit-up problems, plus the fact that at comparable frequencies other sources provide more economical power, has led to

increasing disuse of motor generators for induction brazing.

The spark-gap converter employs a transformer to step-up its a-c input and charge condensers. The current is then discharged across a spark gap, creating heat for brazing. Spark gap equipment, unfortunately, requires continual maintenance which increases costs wherever it is used.

Most efficient—and most popular—of the three types of current sources for induction brazing is the vacuum-tube oscillator. It provides frequencies that effectively heat both ferrous and nonferrous metals, and which do not force the user to engage in highly-exacting fit-up work.

Induction heating equipment for brazing offers these important advantages:

(1) good heat distribution;

(2) accurate heat control;

(3) uniformity of results, even with unskilled labor;

(4) speed.

The process does, however, force the user to carefully develop—and strictly adhere to—a set of conditions for brazing, and to pay closer attention to joint design than is necessary in using simpler, more flexible equipment.

Furnace brazing. Like the induction process, furnace brazing is valuable when repetitive production is demanded. This process is also akin to induction brazing in that the alloy—in any of the various available shapes—can be preplaced at the joint.

Gas, electricity and oil are the elements used to fire the four types of brazing furnaces: box, retort, conveyor and bell. Parts placed in any of these furnace types are normally fluxed, unless a protective or controlled atmosphere is used (and even in this latter circumstance, a small amount of flux may still be called for).

Controlled atmospheres, which are not a substitute for thorough parts cleaning procedures prior to brazing, can be created through the introduction of purified inert gases (argon or helium); combusted fuel gas; dissociated ammonia; cylinder hydrogen; deoxygenated and dried hydrogen, or through vacuum pumping.

Of the four furnace types, only the conveyor handles parts on a *straight-through basis.* The box, retort and bell furnaces are commonly known as *batch* types.

Conveyor furnaces produced in recent years specifically for brazing work have both heating and cooling chambers. Many users have additionally modified other furnace types so that controlled cooling can become an integral part of the brazing operation.

Modern machines insure accurate and repetitive brazing results through a system of automatic controls regulating temperature, time and, where applicable, atmosphere. These three factors, incidentally, are the basis for selection of a proper furnace brazing machine.

Dip brazing. This process is so-called because parts to be brazed are jigged and placed in a chemical or molten metal bath which is maintained at a correct brazing temperature. The alloy, of course, is preplaced on parts immersed in both baths.

For molten metal dip brazing, refractory bricks or graphite form the crucible containing the metal. Over the top of the molten mass is placed a cover of flux. The parts must also be fluxed after thorough cleaning.

Molten chemical (salt) baths also employ a container (metal or ceramic). The salts are generally of the cyanide or chloride type, which

Glossary
of brazing terms

Capillary attraction: action by which brazing alloy is distributed through joint. Caused by adhesion between base metal and molten filler, plus surface tension of filler metal.

Coupling: gap between part to be brazed and induction coil. May be *close* (small) to *loose* (large).

Face-feed: manual application of brazing alloy.

Flow point: temperature at which brazing alloy moves readily through a joint. Should not be confused with *liquidus.*

Liquidus: temperature at which a brazing alloy is no longer solid.

Plastic range: temperature range between liquidus and flow point. Alloys with shortest plastic range usually have best flow quality.

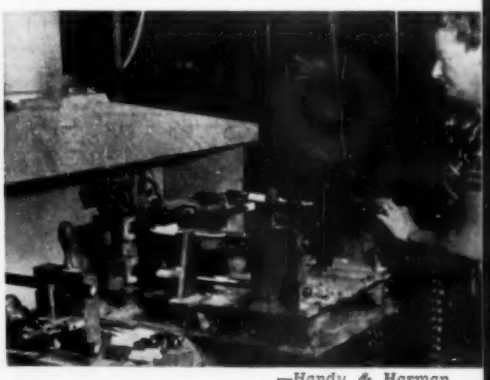
Solidus: temperature at which a brazing alloy begins to solidify.

Wetting: action of molten filler metal in covering cleaned and fluxed areas of base metal. Flux removes surface oxides of base metal to permit this phenomenon. Wetting occurs because molecules of alloy and base metal have mutual attraction.

Right:
furnace brazing.

—Convair Fort Worth

Extreme right:
induction brazing.



—Handy & Harman

provide a mild fluxing action. If heavier fluxing is desired, other salt mixtures may be used.

Parts to be dip brazed by either method must often be preheated. Following this operation, they are moved quickly to the bath to avoid excessive heat loss. When immersion is completed, cleaning operations are immediately begun to remove flux.

In both dip brazing methods, the crucibles must be large enough and the heating method (gas or oil, or resistance heating) efficient enough to prevent any appreciable drop in temperature of the molten material when parts are dipped.

By any standards, today's manual and automated brazing processes are doing a man-sized job. Without them, for example, jet aircraft and automobiles, household appliances and metal furniture would be bulkier, costlier and less streamlined.

But the selection of a process versatile enough to suit all his needs doesn't equip the user to immediately begin brazing operations. His next consideration—an equally important one—is *joint design*. In the following article are the important design steps he must know.

the joint designs

—most are modifications of joint types for welding

JOINT TYPES which can be used for gas or metal-arc fabrication may also be employed when brazing is the joining method. But in most instances, the basic joint types (butt, tee, lap, edge, corner) must be modified to give greater strength.

Brazing alloys do not usually possess strength equal to that of the base metal. For this reason—and for others cited below—designers can increase strength of a brazed assembly by paying careful attention to joint character.

A butt joint, for example, presents a limited joint area to which brazing alloy can bond. So, unless product appearance or other considerations dictate its use, the butt joint should be by-passed in favor of a sturdier lap joint.

The scarf joint illustrated with this article is also a possible substitute for butt joints. It should be designed to give a joint area over three times that of a butt joint. Scarf joints, however, are difficult to prepare and even more difficult to hold in alignment.

Other important factors affecting joint design are:

1—Service requirements.

2—Brazing process to be used.

3—Type of fabrication techniques which have been used on an assembly prior to the brazing operation.

4—Number of parts to be brazed, or extent of repetitive joining.

5—Desired or required method of filler metal application.

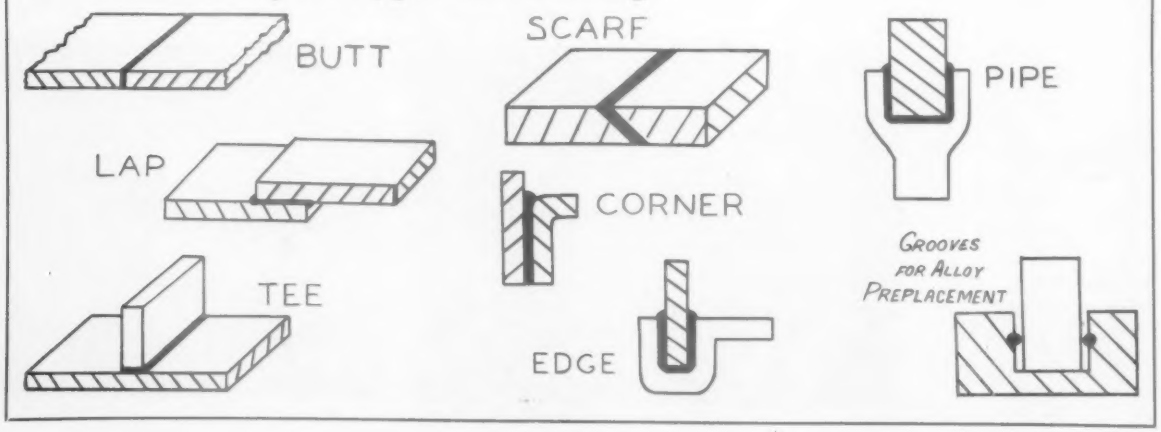
Service requirements exert considerable influence on those charged with the responsibility of designing joints to be brazed. The brazed assembly may, for example, have to provide good electrical conductivity . . . it may have to be pressure tight . . . it may have to be used under conditions of extreme heat or cold . . . or it may be subjected to a variety of stresses.

Each of these service conditions, when related to the given factors of base metal and parent metal types—plus brazing process to be used—presents new problems to the joint designer.

The illustrations accompanying this article depict some of the many joint modifications which have been developed to give brazed parts needed characteristics for a multitude of uses.

Once the selection of a proper joint design has been made, a further problem must be dealt with by the user—that of *joint clearance*. Just what this measurement may be is dependent upon the type of base

Some common joint types for brazing



and filler metals; base metal thickness; mechanical strength desired; surface condition of parts; type of process used to braze the parts, and the distance the alloy must flow.

Given the following mistakes in joint clearance, here are results a brazing fabricator may expect:

Excessive clearance: filler metal waste . . . possible loss of capillarity . . . probable joint weakness.

Insufficient clearance: voids and flux inclusions . . . loss of joint strength.

No allowance for base metal expansion: possible metal-to-metal contact at brazing temperatures, preventing normal capillary flow. Enlargement of the joint gap may also result from thermal expansion in instances when one part is fitted inside another which has a higher coefficient of expansion.

No allowance for filler metal shrinkage: creation of a concave joint surface—or possible notch effect—that will be a potential stress raiser. Bending may cause joint failure through tearing.

When certain alloy forms are to be preplaced, their presence in or near the joint will have an important bearing on joint design. Naturally, the use of wires, shims, washers or strip forms will entail the most extensive design planning. But preplacement of brazing alloy in powder or paste form also necessitates design allowances.

An alloy form which has a mass which is too great to allow simple preplacement in a joint may have to be placed in a groove machined in the larger of the two sections being joined. Upon heating, the alloy flows out of the groove and through the joint, leaving the groove as a void.

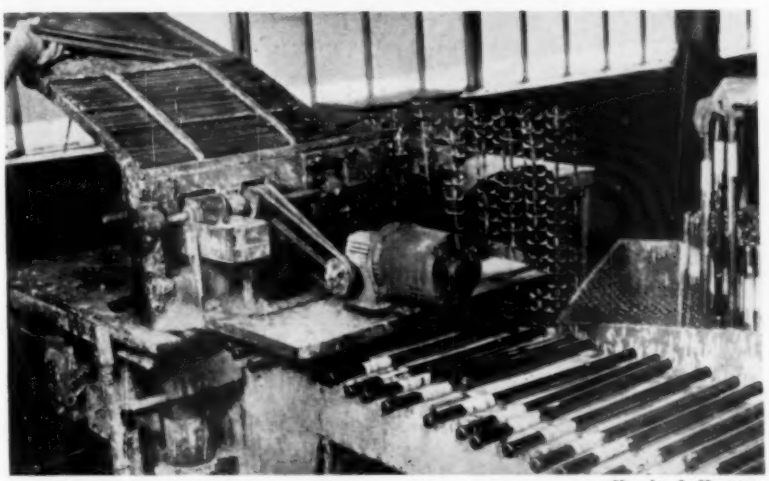
The presence of this joint-weakening void must obviously be surmounted, and the best way is to subtract the groove from the joint area when making design calculations for strength.

the fluxes —they play a dual role of attack and protect

LIKE A DOUBLE-EDGED SWORD, brazing fluxes serve in a dual capacity of "attack and protect."

In its primary role, brazing flux attacks those oxides which coat metal surfaces and hinder brazing. At the same time, it must protect against formation of new oxides.

Brazing fluxes, however, are *not* primary cleaning agents. Parts to be brazed must first be cleaned of all existing oxides, oil, grease and other foreign matter by either degreasing, grinding or pickling.



—*Handy & Harman*

FLUX is brushed manually onto parts to be brazed in most instances, but it can also be applied by a machine like this in repetitive, volume-production situations.

Two other characteristics of these fluxes are important to the brazing operation. At brazing temperature, flux must be readily displaced by the molten filler metal, and surface tension must be such that the flux will wet the metal to aid filler metal flow.

Making up this workhorse of the brazing process are several chemicals —used singly or in combinations to achieve the desired properties mentioned above. Some of the most common ingredients of fluxes—sodium, potassium, lithium—are included in the following chemical compounds: borates, fused borax, fluoborates, fluorides, chlorides, boric acids, alkalies, wetting agents and water (either as water of crystallization or as an addition for paste fluxes).

Flux choice and application greatly influence brazing time and braze quality. But since there are so many variables (*i.e.*, base metal, filler metal, brazing method, joint complexity, etc.) no one universal flux is best for all brazing applications.

(Fluxes have been grouped into six general types in the AWS specification *Fluxes for brazing*. Each flux in the specification will perform satisfactorily in the range designated, but the manufacturer's recommendation should first be considered and trial runs are advisable when experience is lacking.)

A particular flux must be chemically compatible with all base and filler metals involved in order to gain best results. It must further be active throughout the brazing temperature range. Knowing properties of two of these three factors—filler metal and/or temperature, and base metal —one or more fluxes can be found for the particular combination required. When more than one flux is

Pre-braze cleaning

That base metal surfaces should be as clean as possible is a foregone conclusion whenever brazing is done. But all too often, those who braze think the flux they use will remove everything short of rust from the base metal.

This is definitely not the case—*even though some of today's efficient fluxes are capable of cutting through some light oil or oxide films, and of floating away small particles of dirt and scale.*

Fluxes are used (1) *to prevent oxide formation during brazing, and* (2) *to protect the alloy as it solidifies after brazing. Any disintegrating effect they may have on existing oxides should not be relied on. Instead, the user should employ any of several chemical or mechanical cleaning methods.*

In the mechanical cleaning category are such commonly used methods as grinding, filing and wire-brushing. Light machining can also be applied if it will not seriously affect joint tolerances. Mechanical cleaning in any form, however, is not as efficient as that done by chemical means.

Various chemical agents—among the most common of which are carbon tetrachloride, trichlorethylene *and* trisodium phosphate—*do a more thorough oxide and dirt-removal job. In addition, they do not remove base metal or otherwise change parts dimensions. Any residue of these chemical cleaners should always be removed after cleaning so they will not form a film or corrode base metal.*

Cleaning by either mechanical or chemical means should immediately precede brazing. Parts that are cleaned, then stored for some length of time, may not have sufficiently clean surfaces when the brazing operation is finally scheduled.

Just which cleaning method should be used for specific metal types is a matter best handled by the metal supplier.

recommended, other considerations (*e.g.*, safety and cost) will enter into the decision.

Maximum efficiency of a flux can be obtained if the following standards are considered when choosing flux:

(1) For dip brazing, water and water of crystallization must be avoided.

(2) In resistence brazing, flux mixture must allow passage of current.

(3) The flux's effective temperature range must include the brazing temperature for a specific filler metal.

(4) Ease of flux removal should be considered.

(5) Choice of flux should be such that corrosive action on base or filler metal is minimized.

FLUX removal after brazing is as important as initial fluxing operation. Boiling water and acid rinses effectively remove corrosive ingredients.

Generally, fluxes are available in three forms—powder, paste or liquid. Brazing process, brazing procedure and individual working requirements dictate which form will be used.

Of the three, paste is the most commonly used, although frequently powdered flux is mixed with water or alcohol to give it a paste-like consistency.

Dry powdered flux may be sprinkled on the joint (although adherence is not as good) or it may be applied to the heated end of a filler rod. Dry powdered flux is also used in chemical dip brazing. Liquid flux is obtained when certain flux ingredients, because of chemical characteristics, can be dissolved completely in water.

If paste flux is to be brushed on, it should have the consistency of heavy cream—but only if the parts are copper, brass or ordinary steel of moderate thickness. For all types of stainless steel, the paste should be fairly thick in order to withstand the metal's tendency toward local overheating.

When parts to be brazed are large and/or heavy, and require a long heating cycle, the paste should be very thick—regardless of the base metal—in order to absorb the oxides formed during lengthy heating.

A too-thick coating will do no harm and can be removed, but a too-thin coating is likely to pull away when heated and permit oxidation. Since flux bubbles at its edges when heated, the paste should extend well beyond the joint seam to prevent oxides entering.

Appearance of the flux while parts are being brought to brazing temperature can act as a guide:

(1) Water boils off at 212 F.

(2) Flux whitens and becomes slightly puffy at 600 F.

(3) Flux wets the surface and appears milky at 800 F.

(4) Flux is completely liquid and clear at 1,000 F.

Most low temperature brazing alloys melt between 1,100 and 1,200 F, so the operator can apply the filler metal a few seconds after the flux is liquid and clear.

One other method of preventing oxidation on parts to be brazed should be mentioned: *controlled atmosphere.*

Like the brazing fluxes, a controlled atmosphere is *not* a cleaning agent, but sets up an "offense-defense" action against oxidation.

Controlled atmospheres are most commonly used in furnace brazing but may also be used in induction and resistance brazing in special cases. In certain applications, controlled atmosphere is more desirable since flux may damage or contaminate some types of equipment, (*i.e*, metallic muffle furnaces and vacuum systems).

With proper consideration for all the factors influencing brazing fluxes, good adhesion of brazing alloys is never left to chance.

Filler metals for joining

—*Handy & Harman*

TORCH brazing—probably the most widely used brazing method.

by **Orville T. Barnett***

THE NUMBER of new brazing alloys is growing almost daily.

The stimulant given to manufacturers of brazing filler metals is the ever-expanding use of brazing as a joining method; yet, although a recent list showed about 70 brazing alloy compositions, the latest AWS-ASTM specifications cover only 29 alloys. This selectivity is possible because, though numerically few, these metals represent the greater amount of consumption.

What is brazing? The American Welding Society defines it as ". . . a group of welding processes wherein coalescence is produced by heating to suitable temperatures above 800 F and by using a nonferrous filler metal, having a melting point below that of the base metals. The filler metal is distributed between the closely fitted surfaces of the joint by capillary attraction."

Good filler metals perform several important functions. They must:

(*1*) wet the base metal. There are several ways to increase wetting, of course. Reducing atmospheres or flux will promote wetting, as will the addition of such elements as phosphorus, lithium and boron to remove base-metal oxides;

(*2*) give good balance between melting and flow characteristics to permit full alloy distribution;

(*3*) have an homogenous and stable composition to avoid *liquation* (*i.e.*: the premature release, due to slow heating, of a low-melting-point constituent in the alloy, leaving a low-strength skeleton comprised of elements with higher melting points);

(*4*) be free of volatile ingredients that would make a porous, unsatisfactory weld;

(*5*) add strength, ductility, high-temperature resistance, corrosion resistance, etc., to the joint.

Brazing filler metals are divided into seven classifications. In order of popularity, these are: silver, copper and copper-zinc, copper-phosphorus, aluminum-silicon, heat-resisting materials, copper-gold, and magnesium.

Such alloys are produced in many forms—wire (in coils), rod (36-in. lengths), strip, coated sheet, powder (40 to 325 mesh), or grain (3 to 70 mesh). Frequently, brazing alloys are preformed into rings or special shapes to simplify placement of a correct amount at the joint.

Before discussing these filler metals more fully, however, several definitions should be given. In the abbreviations used, *B* represents brazing filler metals, and *RB* signifies either welding rods or brazing filler metals.

In the classification RBCuZn-A, for example, *Cu* and *Zn* refer to the filler's composition, copper and zinc. The suffix *A*, and sometimes a number, as in BAg-*1*, is used to separate members of a family, each containing the same elements but in varying amounts.

Solidus (melting point) is the highest temperature at which the metal is completely solid—the temperature at which melting starts.

Liquidus (flow point) is the lowest temperature at which the metal is completely liquid.

Brazing temperature is always above the solidus. This compensates for heat imbalance, contributing to quick melting and rapid flow.

Joint clearances range from shrink-fits used in copper-brazed joints to 0.010 in. in light metals like aluminum and magnesium.

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Without question, the most popular filler metals for brazing are the silver alloys, which sometimes are inaccurately and deplorably termed "silver solders."

BAg Classifications

Although AWS-ASTM classifications in this field do not include all silver alloys commercially available—like silver-lithium types preferred by many for better wetting—the advantages of unlisted alloys should always be kept in mind.

Alloys in the BAg family will join all metals except aluminum, magnesium, and those metals with melting points below 1,500 F. Quick-melting and free-flowing, they can be deposited by all brazing methods, including vacuum, inert-gas and reducing atmosphere brazing. Flux is generally used with all these methods.

Silver alloys are applied to a wide variety of products such as electrical parts, plumbing equipment, household goods and heating fixtures.

BAg-1, BAg-1a, and **BAg-2** are free-flowing metals designed for common joint types. BAg-2 has a wider melting range than the first two alloys and, accordingly, must be rapidly heated to forestall liquation.

BAg-3 and BAg-4 are prominent in brazing carbide tool tips to shanks. BAg-3 is a good corrosion resistant material with a whitish-yellow color after brazing. It is often selected for brazing stainless steel and for bridging gaps and making good fillets. BAg-4 is slightly more free flowing and is light yellow after deposition.

BAg-5 and **BAg-6** are general-purpose alloys used at higher brazing temperatures. Because they are cadmium-free, they are often specified for dairy and food processing equipment, and find wide use in the electrical industry. After brazing, their color is also light yellow.

BAg-7, another cadmium-free alloy, also is frequently purchased for brazing dairy and food handling equipment. As a low-melting, general-purpose alloy, it is a favorite for furnace brazing. Its whitish color after brazing is considered desirable by many fabricators of stainless steel.

BAg-8, the silver-copper eutectic, is often used in assembling electronic and vacuum tubes. Although the metal is generally free-flowing, it does not respond well on ferrous metals except in vacuum brazing. Its post-brazing color is white.

—*Handy & Harman*

DIP brazing in a chemical salt bath. Alloy has beeen preplaced. Although some flux can be used, primary fluxing action is provided by salt.

BAg-9, BAg-10 and **BAg-11** are sterling silver alloys. Possessing steadily increasing brazing temperature ranges, they are ideal for step brazing. (Step brazing is necessary when more than one braze is to be made in an assembly at different times. A higher melting point alloy is used on the first joint, and lower melting point alloys for succeeding joints.) These types are white after brazing.

BCu and BCuZn

Although AWS and ASTM specifications describe only three filler metals in the copper and copper-zinc classifications, there are actually five.

RBCuZn-B and **RBCuZn-C,** the unlisted alloys, can be used on some types of bicycle frames and on tubular steel furniture. No capillary attraction takes place, however, and this is not considered true brazing.

The BCu group is frequently chosen—with a shrink fit—for brazing ferrous metals or nickel and copper-nickel alloys. Furnace brazing is most widely employed with a hydrogen or dissociated ammonia atmosphere.

If alloys are to be brazed whose elements are difficult to reduce—aluminum, chromium, manganese, silicon, titanium, vanadium, and zinc—a flux must be applied. (Powdered copper oxide can be substituted for BCu filler metals when furnace brazing is done in a reducing atmosphere.)

RBCuZn-A is effective on steel, copper and its alloys, nickel and its alloys and on stainless steel. However, the corrosion resistance of this alloy is often different from that of some base metals on which it is deposited. This fact becomes particularly important when metals like copper, silicon-bronze, copper-nickel or stainless are selected because of their corrosion resistance.

The RBCuZn alloys should not be overheated. The zinc may volatilize and cause porous joints. The copper-zinc family may be brazed by torch, furnace or induction heat, and flux must be used.

RBCuZn-D (known as white brass or nickel silver) can weld steel or nickel and its alloys by any brazing method.

BCuP Classifications

In addition to the five alloys classified by AWS-ASTM for copper-phosphorus filler metals, there is a sixth which is quite popular—**BCuP-6.** This contains 2% silver in addition to its copper-phosphorus content. It behaves much like BCuP-1 and BCuP-2 but will bridge wider gaps.

This group is used for brazing copper and copper alloys. Joints made with these alloys have excellent thermal and electrical properties.

How to select silver brazing alloys

No.	Composition, per cent					Melting Range		Recommended brazing temp., deg F	American Platinum Works (S = Silvaloy)	Goldsmith Bros. (GB)	Handy & Harman (E = Easy-Flo)	Unit. Wire & Sup. Co. (S = Sil) (SB = Sil/-Bond)	ASTM		Federal Spec QQ-S-561d	Mil. S-15395 Ships	SAE Aero. Mat'l Spec.	No.
	Ag	Cu	Zn	Cd	Other	Solidus deg F	Liquidus deg F						B73-29	B260-52T				
1	85				Mn 15	1760	1778	1800	850	85	85Ag-15Mn	S-85M	2	BAg Mn	(Superseded	(Superseded	4776	1
2	80	16	4			1360	1490	1500	A-49	80	IT	S-80	8		U. S.	Navy		2
3	75	22	3			1365	1450	1450	Hard	75	Hard			BAg 11	Air	47-S-13C)		3
4	75	20	5			1350	1425	1450			#1				Force			4
5	75		25			1310	1325	1325	K-427		Tr #1				Spec			5
6	72	28				1435	1435	1450	301	72	BT	SIL-72		BAg-8	11342)			6
7	70	20	10			1335	1390	1400	Med.	70	Med.	S-70	7	BAg-10				7
8	65	20	15			1280	1325	1350	Easy	65	Easy	S-65	6	BAg-9	2			8
9	65	28			Mn5, Ni2	1380	1450	1500			RE-MN							9
10	60	25	15			1260	1325	1350	A-33	60	RT	S-60						10
11	60	30			Sn 10	1120	1370	1350	60		RT-SN	S-60T						11
12	60	27			In 13	1125	1370	1300										12
13	56	22	17		Sn 5	1145	1205	1250	S-355	56	ER	S-56T		BAg-7				13
14	54	40	5		Ni 1	1375*	1575	1600	54	54	4772	S-54N					4772A	14
15	50	15.5	16.5	18.0		1160	1175	1175	S-50	50	E 50	SB-50		BAg-1a	4	IV	4770B	15
16	50	15	25	10		1160	1185	1200							6A			16
17	50	34	16			1275	1425	1425	S-25	250	ETX	S-50	5	BAg-6				17
18	50	15.5	15.5	16	Ni 3	1170		1270	503	350	E #3	SB-50N		BAg-3	5	V		18
19	50	28	22			1250	1340	1350	A-28		ET							19
20	45	15	16	24		1125	1145	1150	S-45	45	E 45	SB-45		BAg-1		VII		20
21	45	30	25			1250	1370	1375	A-18	145	DE	S-45	4	BAg-5	1			21
22	45	18	21	16		1140	1190	1180										22
23	41	17	18	24		1125	1190	1160		41								23
24	40	18	15	27		1135	1205	1200										24
25	40	30	28		Ni 2	1240	1435	1400	S-250	240	SS	S-40N		BAg-4				25
26	40	36	24			1250	1400	1400	A-14		DT	S-EEN						26
27	40	30	25		Ni 5	1250	1600	1500	254	540								27
28	35	26	21	18		1125	1295	1300	S-35	35	E 35	SB-35		BAg-2		VIII	4768T	28
29	30	29	21	20		1125	1300	1300		31								29
30	30	38	32			1370	1410	1400	A-13		NT	S-30						30
31	20	45	30	5		1140	1500	1400	S-20	20	ATT	S-20C	3					31
32	20	45	35			1430	1500	1450	A-11		AT Spec.	S-20	2		0	0		32
33	15	80			P 5	1185	1500	1300	S-15	15	Sil-Fos	PHOS. 15		BCuP-5	3	III		33
34	10	52	38			1550	1580	1580	A-4	110			1					34
35	7	85			Sn 8	1225	1805	1550	D-7		SN #7							35
36	6	86.5			P 7.5	1185	1380	1300				PHOS. 6		BCuP-4				36
37	5	58	37			1575	1600	1600			TE Spec.	S-5						37
38	2	91			P 7	1185	1450	1300		1270								38
39	5	88.75			P-6.25	1190	1500	1300	5		Sil-Fos 5			BCuP-3				39

Corrosion resistance will be good except in sulphurous atmospheres at elevated temperatures. And, if properly used, BCuP filler metals have superior tensile and shear properties.

Occasionally, one of the family is chosen for brazing silver, tungsten and molybdenum. However, they are unsuitable for ferrous metals or for alloys with more than 10% nickel because of their high phosphorus content.

They can be brazed by any of the processes. These alloys seem most effective when used with lap and sleeve joints. Joint clearances preferred are 0.001 in. to 0.005 in. As is true with most brazing design, butt joints are usually avoided.

These metals are self-fluxing when copper is brazed to copper but a flux is recommended when they are applied to other metals—including copper alloys.

There is a tendency for the copper-phosphorus types to liquate if heated slowly or for a long time, so heat them as rapidly as good practice permits. This precaution is doubly necessary when the brazing alloy is preplaced.

BCuP-1, a low-cost alloy with a wide melting range and low fluidity, is preplaced in the joint. It is used on electrical connections with resistance brazing and sometimes supplements spot welding.

BCuP-2 is ideal for radiator welds, air conditioners and electrical connections. Despite the fact that its physical properties are quite good, it will not withstand severe vibrations.

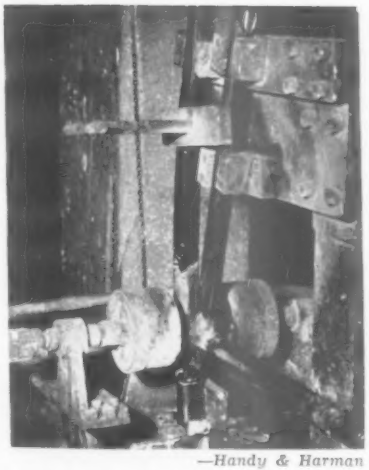
BCuP-3 was designed for joints where close fit-ups cannot be maintained. Although it is similar to BCuP-2 in its brazing temperature range, it is more ductile and has the added ability to fill gaps and form fillets without losing strength qualities.

BCuP-4 has the lowest brazing temperature in its group and was developed for close fit-ups.

BCuP-5 also is a good alloy for joints where close fit-ups are impossible and joint ductility is of especial importance.

BAlSi Classifications

These aluminum and silicon filler metals were produced to braze aluminum and aluminum alloy-types 1100, 3003, 3004, 5250, 6951, 6053, 6062 and 6063 (in wrought form), and A 612 and C 612 (in cast form).



—*Handy & Harman*

FUEL gas mixed with air provides flame for this torch brazing setup in which parts with preplaced alloy and flux are fixtured in front of multi-flame tip.

BAlSi-1, BAlSi-2 (available only as a coating on 3003 and 6951 sheet) and **BAlSi-3** have proved best for furnace and dip brazing while **BAlSi-4** was designed for torch brazing, although it has occasionally been used for furnace and dip brazing. BAlSi-4, incidentally, is the only member of this group marketed as a powder.

No matter which brazing process is selected for use on aluminum, flux is always necessary. Like ordinary welding flux and slag, flux must be removed from the finished joint in order to prevent it from becoming a source of corrosion.

Even though aluminum brazing must be carried out with great care—the filler metals often melt only 100 F below the base metal—many complicated units can be formed which would be impossible by any other joining method. Thin sections are readily welded to thicker ones. Many joints can be made simultaneously by furnace or salt bath brazing. Among the parts joined by aluminum brazing are radiators, heat exchangers and refrigerator assemblies.

Heat resisting materials

Heat resistant filler metals were first developed for brazing high-nickel and stainless steel alloys destined for high-temperature service in jet engines; as more and more alloys are added to the group there is an expanding interest in them for applications in atomic reactor technology.

BAgMn, remains strong in the 500 to 900 F temperature range. It is generally deposited by furnace brazing with a reducing atmosphere.

BNiCr filler metals retain strength at even higher temperatures—up to 2,000 F. Actually, there are BNiCr filler metals containing chromium, silicon and/or boron or phosphorus. **BNiSib** differs from the first group in that it has no chromium. **BNiP** contains nickel and phosphorus and/or boron.

These heat-resistant materials are usually applied by furnace brazing in a dry-hydrogen atmosphere. Small, controlled amounts of filler metal are recommended for long-term, high-temperature service—for instance: when thin base metals must be brazed (as in honeycomb sandwiches) and the joint is threatened by diffusion of alloy into base metal. These alloys form brazes distinguished by their corrosion resistance.

BCuAu Classifications

Copper-gold filler metals are used in inert, reducing or vacuum atmospheres for brazing electronic tube assemblies where volatile constituents would cause operating trouble. Step brazing is practical with these alloys because of the spread in the brazing temperature range between them. Induction, furnace or resistance brazing are common methods of depositing these filler metals. For certain applications other than electronic tubes, a borax-boric acid flux is specified.

BMg Classifications

When magnesium is used to braze MI magnesium base metal, all brazing processes are used except resistance heating. As on aluminum, heating must be done carefully to avoid melting the base metal. Again, complete removal of flux after brazing will result in good joint corrosion resistance. Beryllium is only added to the metal to stop it from bursting into flame when furnace brazing.

Yes, the number of brazing filler metals is constantly expanding; their services are becoming increasingly important to fabricators of all kinds. And they will continue to grow. For brazing solves problems almost insurmountable by other joining methods.

Chapter I in a new Welding Engineer series . . .

The fundamentals of *welding engineering*

- Earliest foundations
- Recent developments:
  - . . . gas
  - . . . arc
  - . . . resistance
- Impetus of two wars
- Where welding is used

by **T. B. Jefferson**

IN THE SHORT SPAN of 30 years, welding has grown from a laboratory experiment for joining metals to the most important fabricating process in the metal-working field.

Without welding, many of the products we now accept as commonplace would be non-existent.

Without welding, it's doubtful that the industrial progress of the 20th century could have been possible.

Certainly, we would not enjoy the many advantages of present-day mass production and transportation facilities if it were not for welding.

Historically, welding through related processes dates back to the early Egyptians and Syrians. These early civilizations, historians guess, may have become acquainted with fire or forge welding some 3,000 years ago.

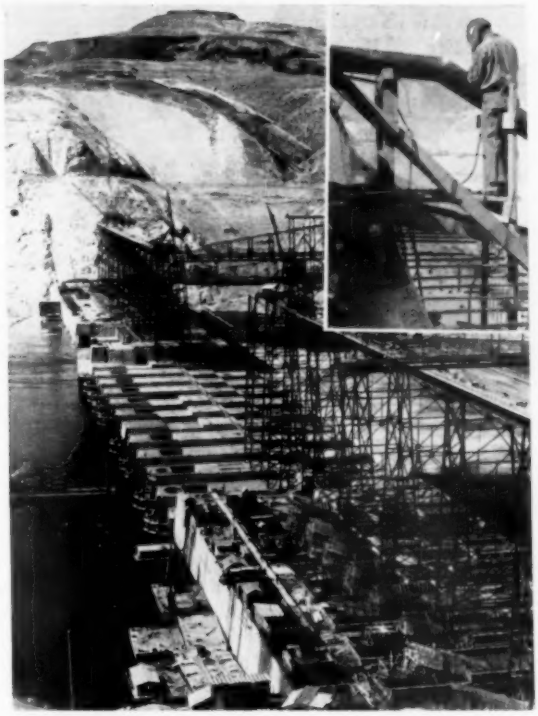
Prehistoric Man probably discovered metal as the result of a fire built on the sands of some lake shore in a middle eastern area. In all probability, copper and other ores with low melting points were mixed in these sands. The heat of a fire melted them, and out of the fire trickled an extremely hot fluid which cooled and solidified.

It was at this point that Man realized he had a new material—*metal.*

His newly-disovered product was not in usable shape; it was simply a metal icicle in the sand. But Man soon learned he could take sand and make small molds into which the melted ore would flow.

To obtain even more usable metal pieces, ancient Man once again conducted his crude experiments with fire and found that cast shapes could be joined in the flame to form implements. This was the beginning of welding—and brazing.

As Man's experience taught him new lessons, he saw that an uncontrolled fire was hardly an ideal medium



GRAND COULEE, one of the world's largest dams (4,300 ft long, 550 ft high), provided welding with one of its major proving grounds. Constructed in the state of Washington from 1933 to 1941, Grand Coulee's strength and efficiency is based largely on miles of welded reinforcements and piping.

with which to melt and form metal. He found, too, that certain liquids—alcohol and oil—were flammable and *could* be controlled by passing them through tubes.

The next step was undoubtedly an easy one, and it gave Man an antiquated version of what we now call gas welding. The Greeks and Romans, as well as Etruscans and Egyptians, applied pressure to the burning fuel oils. The blow-torch effect thus created helped concentrate heat and make it more efficient. But it wasn't until the much later discovery of gases yielding higher temperatures that we had a true gas welding process.

Early gas welding attempts in the past 125 years seemingly were carried out with the oxyhydrogen flame. The reason for this is that scientists were able to produce oxygen and hydrogen through chemical reaction, or the decomposition of water, without the separation of component parts.

Records indicate that, as early as 1847, Robert Hare of Philadelphia, successfully used the oxyhydrogen flame to fuse 2 lb of platinum. Other flames employed were

oxygen-coal gas and air-hydrogen mixtures.

Gas welding in the 19th century, however, was confined to the laboratories or to working such precious metals as silver and gold. Industries of the day—like some in our times—kept right on joining metal in the same way their predecessors had joined wood.

Even though, in 1880, industrial electrolysis of water for oxygen and hydrogen production increased the scope of gas welding, it was still a lab-confined process.

Acetylene gas, accidentally discovered by Edmund Davies in 1836 and announced as a calcium carbide derivative in 1862 by the physicist Woehler, provided gas welding with its greatest impetus. But not coincidentally with Woehler's discovery.

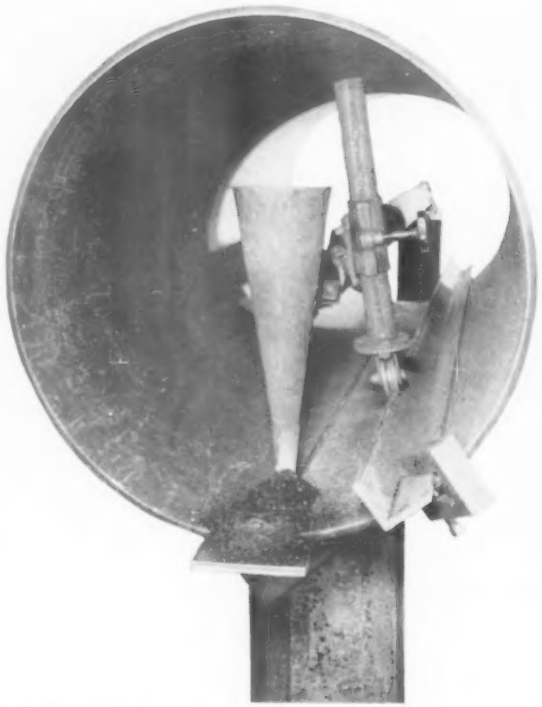
It wasn't until 1892 that Thomas L. Willson of Spray, N. C., found a commercially feasible way of producing calcium carbide while trying to make metallic calcium. Within three years, Willson's associates, James T. and John M. Morehead, had established facilities to economically produce calcium carbide, and acetylene gas became a valuable illuminant.

At about this same time, French chemist LeChatelier read a paper before the Academie des Sciences in Paris. He described the temperature of flames and stated that acetylene burned with an equal quantity of oxygen produced a temperature 1,000 C (approximately 1,800 F) hotter than the oxyhydrogen flame.

This startling discovery led to the development of the first oxyacetylene torch by Edmund Fouche in 1901. This experimental model was a high-pressure type, for at that time acetylene was compressed under several atmospheres of pressure in cylinders containing acetone. So, since both oxygen and acetylene were compressed under high pressure, it was relatively easy to obtain a good mixture of the gases as they entered the torch.

When Fouche was later employed by a firm producing low-pressure acetylene generators, he designed a torch that could operate with low gas pressures. High-pressure oxygen, upon entering the mixing chamber of the new torch, expanded and drew acetylene from its orifice by the injection principle. (Both this torch and the earlier Fouche model incorporated principles present in our modern low- and medium-pressure types.)

STUD welding, developed during World War II by Mare Island weldor Ted Nelson, eliminates need for drilling bolt holes by end-welding headless, threaded bolts to plate. On this framework for play sculpture used in San Francisco, 2,500 1½-in. studs hold wire mesh over which concrete is poured.



DEVELOPED just 25 years ago, the submerged-arc process is one of the milestones in welding progress. It provides invaluable service in joining heavy plate at high speeds, and may be used automatically (above) or semiautomatically.

In the U. S., little welding progress was being made. But this situation changed rapidly when Eugene Bournonville brought a gas torch from France in 1906. Its introduction sparked welding's use for commercial purposes, and a major industry was born.

Arc welding, the most popular of all present-day welding processes, is much older than most of its users realize.

The introduction of arc lights in 1881 led to early applications of arc welding. And though the early uses were experimental in nature, they were sufficiently practical to lay the groundwork for two systems of arc welding developed 5 or 6 years later.

In many respects, arc welding may be considered an outgrowth of the electric furnace. In the furnaces of French chemist Henri Moissan and others, metal to be melted was placed in the path of electric current passing between two carbon electrodes.

The first arc welding experiments probably were undertaken by DeMeritens in France in 1881. He joined various parts of a storage battery plate by lead welding, using a carbon arc as a heat source.

Guided by results of this work, N. V. Bernardos, a Russian, perfected and patented (1887) a carbon-arc welding process. This system, however, was cumber-

some and potentially hazardous. Direct current was used, at voltages ranging from 100 to 300 volts, and welding current varied from 600 to 1,000 amp.

Bernardos equipment was operated on straight polarity, which is still the preferred method of carbon-arc welding, and employed carbon electrodes ¼ to 1½ in. in diameter. It was common practice to weld with an arc 2 to 4 in. long. And to make the process still more difficult and as awkward as possible, the electrode holder was over 20 in. long and quite heavy.

Shortly after the Bernardos developments, the Slavinoff system of arc welding came into use—replacing carbon electrodes with consumable metal wire and giving birth to metal-arc welding. An American named Coffin, working on metal-arc welding simultaneously with Slavinoff, was able to obtain a U. S. patent on the process in 1889.

In the intervening years, metal-arc welding has become increasingly popular and important as electrode materials have undergone continued improvement.

Of the many developments put forth in the 20th century with a view to improving metal-arc welding, the first was atomic-hydrogen welding. It employed hydrogen gas to help produce an extremely hot arc that's readily controlled. This basically manual process has also been used automatically to some extent—though it is now generally outdated.

The year 1933 marked an expansion in interest in automatic welding when patents were issued on the submerged-arc process. This new entry made possible the welding of thick sections at high speed. And since the filler wire is submerged in granular flux, the arc is invisible.

In 1942, still another arc welding process came into being. The Tig (tungsten inert-gas) process, patterned to some extent on the atomic-hydrogen method, utilizes a tungsten electrode shielded by an inert gas (helium or argon).

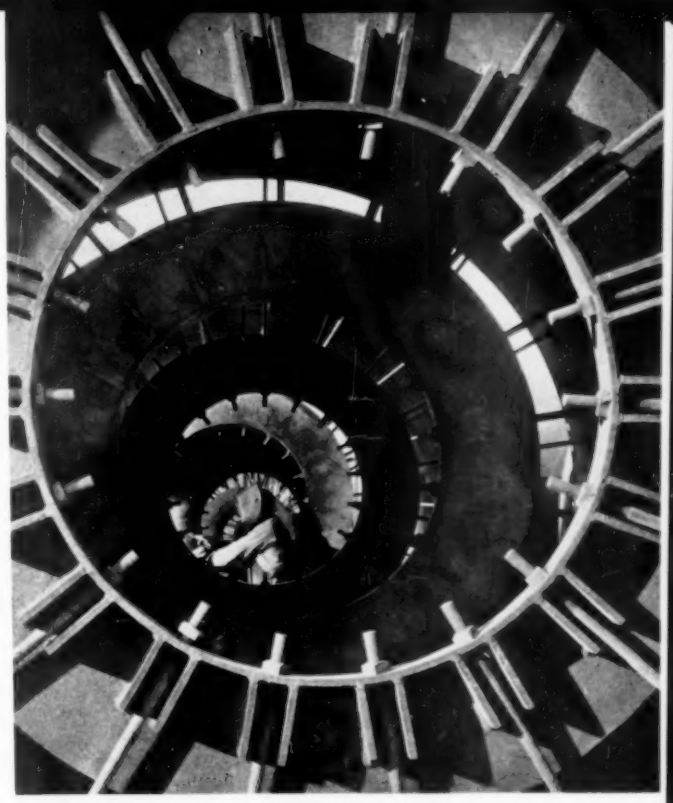
In later stages of development work on the Tig process, it was found that a continuous metal wire could be used both as an electrode and as filler wire. This discovery led to the introduction of Mig (metal inert-gas) welding.

Third on the popularity list of today's welding processes is the oldest of all: resistance welding. It can readily be compared to forge welding in most applications.

Resistance welding principles were discovered by the English physicist, James Joule, in 1856. In his experiments, Joule accidentally welded a bundle of wire buried in charcoal with an electric current. This is believed to be the first application of heating by internal resistance for welding metal. But it remained for Elihu Thomson to perfect the process and develop it for practical application.

Thomson invented a small, low-pressure resistance welding machine in 1877. The machine funneled current into a metal workpiece, and internal resistance of the metal generated the heat which brought it to a plastic state. Pressure then completed the welding job.

For several years following its development, little was done with Thomson's machine. It seemed to possess little commercial value. Nevertheless, resistance welding was introduced commercially in the early 1880's as "incandescent welding."



WELDORS can be found almost everywhere today—manufacing appliances and autos, constructing ships and buildings, fabricating millions of miles of piping. These men in 1957 alone had a hand in the welding of products with a gross value of over $200 million.

Two world wars, strangely enough, have created the conditions in which welding processes have been able to show their mettle. These conditions, however, were not similar in nature.

World War I gave welding a chance to prove itself as a maintenance tool. And on the basis of its successful use, adventuresome businessmen put it to work on the production line. Between 1918 and 1939, all welding processes experienced fairly rapid growth and development.

World War II and the all-out effort it entailed stretched production demands to their limit—and beyond. Welding again saved the day: not as a maintenance tool, but as a joining method which conserved our metal supply.

Before World War II had ended, management executives and engineers were well aware that welding for construction, production or maintenance afforded many desirable advantages. Carrying this knowledge into an unprecedented peacetime production situation, these men and the firms they represent have made welding the most important fabricating method in the transportation and pipeline industries . . . a tool of growing importance in the construction and processing industries . . . and an important means of joining metal in all the diverse industries where metal must be used.

Jobs in welding: They are numerous—and expanding daily.

The three major job categories will be discussed in detail in a forthcoming issue.

In part one of his article, the author discussed the determining factors in selection of chromium-molybdenum alloy steels. The effects of preheat and postheat treatments on weld properties of these steels is evaluated in this second part

Part II

By Jay Bland*

Selection, welding of CrMo alloy steel pipe

CHROMIUM-MOLYBDENUM STEELS are considered air-hardening alloys, so most welding procedures recommend thermal treatments—both preheat and postheat—during welding.

The isothermal curve for 2¼ CrMo steel is shown in Figure 13. These curves represent transformations in steel when cooling from elevated temperatures or when being cooled to a particular temperature and held there for a predetermined time.

Two cooling curves have been superimposed on the diagram—the solid line representing a cooling rate of 8,000 F per minute; the dashed line, 200 F per minute. These rates represent extremes normally encountered in arc welding.

Preheat reduces the cooling rate of weld metal and the base metal heat-affected zone. However, these rates are not reduced significantly below 200 F per minute. Any cooling between the two extreme rates will create a structure in the base metal heat-affected zone having a varied amount of bainite and austenite down to temperatures of about 740 F—the starting temperature of martensite transformation.

Although data is not complete for austenite-to-martensite change below this temperature, it can be assumed that resulting as-welded structures would include bainite and martensite (plus ferrite, since it is a low-carbon alloy). Bainite is an acicular (*i.e.*, needlelike) transformation product of austenite which forms at elevated temperatures (above 740 F). Although hard, bainite is more ductile than martensite.

Figure 14 shows transformation for 5 CrMo steel, using the same cooling curves (8,000 to 200 F per minute). In this case, certain percentage values below the M_S, or starting temperature, represent degree of austenite-to-martensite transformation, essentially complete at 200 F.

Preheated as recommended to temperatures of 500

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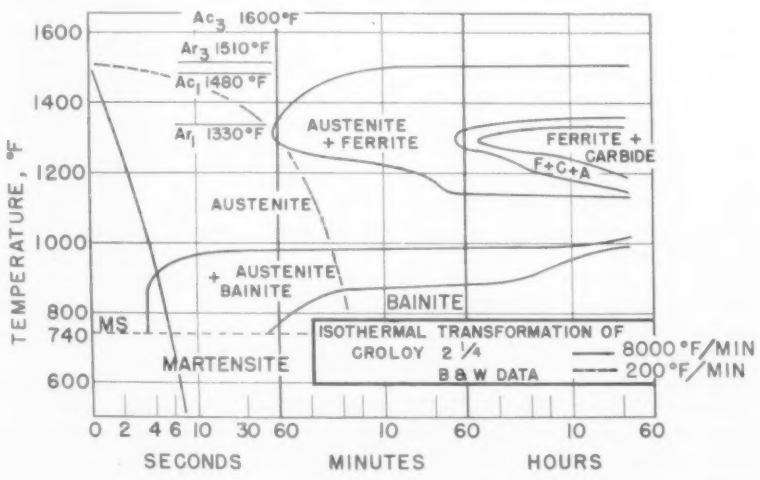


FIG. 13: Isothermal transformation diagram for 2¼ CrMo alloy steel, showing cooling curves for extremes of rates expected in metal-arc welding. Solid line represents 8,000 F per minute cooling rate; dashed line, 200 F per minute.

to 600 F, the 5 CrMo steel's heat-affected zone will cool to these temperatures. If 600 F is used, about 40% of the austenite is transformed to martensite.

Many welding procedures recommend postheat treatment directly from preheat or interpass temperature. In this case, 60% of the structure still to be transformed remains austenitic while the weldment is raised to a 1,350-1,400 F postheat temperature and cooled to room temperature.

In this procedure, most of the 60% retained austenite (if not all) will then transform to martensite. Therefore, taking these CrMo steels to postheat temperature immediately from preheat or interpass temperature invariably results in a final structure containing martensite.

This is not desirable, since the primary purpose of the postheat treatment is to temper or reduce hardness. From a metallurgical point of view, these alloys must be cooled to reasonably low temperatures—generally below 200 F—before postheat treatment is accomplished. Only by producing martensite prior to postheating can a significant reduction in hardness, and consequent increase in ductility, be obtained in the base metal heat-affected zone.

Figure 15 shows data relative to the entire CrMo steel group. The AC_1 temperature line increases with alloy content and is significant in that it represents maximum heating temperature of these alloys in any postheat treatment other than full annealing.

Above the AC_1 temperature, the steel will produce austenite and, on cooling, will transform to martensite. To avoid this condition, extremely slow cooling, such as furnace cooling, must be used. This treatment represents full annealing of the material, and CrMo steels cannot be normalized or air cooled since a hardened structure will result from this rapid rate of cooling.

The M_S line indicates that increasing chromium content will decrease the temperature at which martensite transformation begins. Two dots near the M_S curve represent actual data taken from previous figures for 2¼ and 5 CrMo steels.

Data is available only for the M_F, or finish, of martensite transformation for 5 CrMo steel, shown at about 200 F. Assuming a similar temperature for the range of CrMo steels, it is interesting to note that the dashed lines—representing upper and lower limits of recommended preheat temperatures—fall within M_S to M_F range.

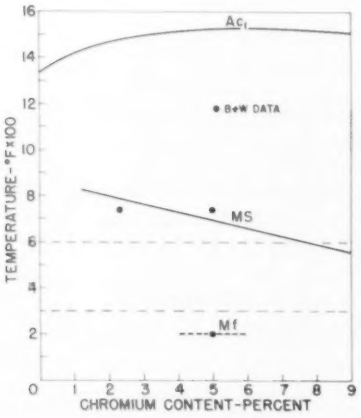


FIG. 15: Graph shows variation with chromium of lower critical temperature, start of martensite transformation temperature, and finish of martensite transformation temperature.

By reducing the cooling rate, preheat is also effective in minimizing cracking tendencies of some CrMo weld deposits, particularly under restraint conditions. In many cases it may be necessary to preheat in order to prevent cracking of root passes.

But once the weld is completed, and assuming no cracks were produced prior to completion, it is believed that cooling below the M_F temperature (about 150 to 200 F) should be allowed so that all retained austenite can transform to martensite. Postheat treatment will then provide maximum hardness reduction and maximum increase in ductility.

Postheat treatment is normally assumed to do two things: *(1)* relieve stresses, and *(2)* reduce hardness of weld and heat-affected base metal areas. As indicated above, hardness was determined more by cooling after welding than by actual temperature involved in postheat treatment. Stress relief is of questionable value in the case of CrMo alloy pipe.

Figure 16 shows approximate residual stresses which might be retained for various stress-relieving temperatures. Many investigators believe residual stress, which might be expected at any stress-relieving temperature, would be approximately the material's yield stress at that temperature.

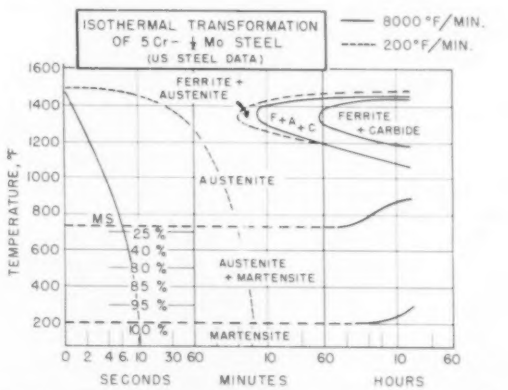


FIG. 14: Isothermal transformation diagram for 5 CrMo alloy steel, showing cooling curves for extremes of rates expected in metal-arc welding.

These curves are plots of the yield strength of various CrMo and plain carbon steels at the indicated temperatures. Based on the assumed yield stress magnitude for residual stresses, postheat treatment at the usual temperatures of 1,100 to 1,300 F and retaining about 17,000 psi residual stress, would not be considered fully stress relieved. Even plain carbon steel at 1,300 F retains stresses of 5,000 to 6,000 psi.

By themselves, these stresses are not too objectionable. As long as loading stresses due to pressure or pipe-bending moments are elastically superimposed on residual stresses, no serious consequence will result. This is also true if the loading produces plastic deformation, provided the material is in a ductile condition.

There are other factors which might be involved. However, postheat treatment for air-hardenable CrMo steels is more effective when considered as a tempering rather than a stress relief treatment.

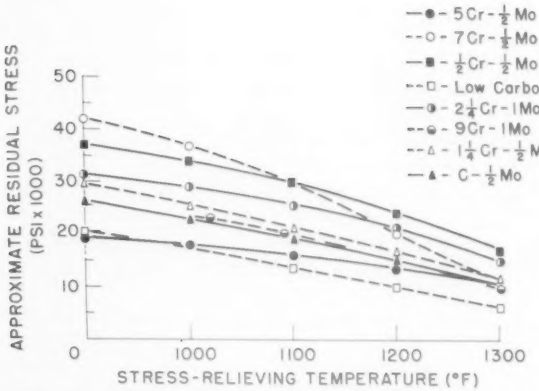


FIG. 16: Graph shows approximate residual stresses for various CrMo alloys postheated at indicated temperatures.

Hardness of base metal heat-affected zones and weld metal for the various CrMo steels, both as-welded and postheated, are shown in Figure 17. Heat-affected zone hardnesses frequently are higher than those of weld metal. This, however, is a variable condition depending greatly on the particular electrode selected.

Assuming a maximum acceptable hardness of 250 Brinell, most alloys can fall within this range after postheating at a suitable temperature. With 7 and 9 CrMo steels, the 250 maximum is sometimes difficult to obtain. Up to about 2¼ CrMo, heat-affected and weld metal hardness as-welded are just about at this maximum.

Many will agree that a 250 maximum for plain carbon steel is objectionable, since at this level it would have low ductility. However, this does not apply to CrMo steels.

Figure 18 shows results obtained on 1¼ CrMo pipe base metal. It had been water-quenched from both 1,700 and 1,900 F, and tempered at different temperatures for various time lengths. The as-quenched material showed an elongation of 16% and a Brinell hardness of almost 390.

Since materials such as T-1 steel—for which ductilities of 17 to 19% are normal and accepted as a material limitation—are used, 16% ductility is not too objectionable. By postheating or tempering CrMo steels at temperatures from 1,150 to 1,350 F, ductility can be

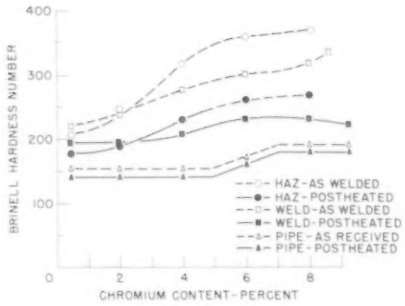


FIG. 17: Brinell hardnesses of various Cr-Mo steels and weld deposits, in both as-welded and postheated conditions.

increased to very good values with a relatively short postheat.

A half hour at this temperature will do almost as much as four hours. This is possible because the test specimens were completely quenched to produce as much martensite as possible. It was the martensite which was tempered.

This tempering operation—if that is the purpose of postheating—occurs in a relatively short time, whereas stress relief at these high temperatures requires a longer completion time because of its relaxation process.

Usual mechanical tests—on which accepted welding procedures are based—will not show differences between possible residual stresses and hardnesses if postheating time was a half hour. This is true, however, only if the material was permitted to cool below the finish of martensite transformation prior to postheating.

Figure 19 shows the relationship between hardness obtained and time spent at various temperatures for 1¼ CrMo steel pipe. Again, a great hardness reduction was obtained in a half-hour treatment with only a slight additional reduction for four-hour postheating. The 1,050 F treatment does not reduce hardness below about 300, but even at this hardness level the parent metal has a 20% ductility.

Postheat treatment at 1,200 F reduced hardness below 250. Accepting this as a maximum, then even 1,200 F (generally below recommended postheat treatment) would do a satisfactory job. Half-hour postheating at this temperature will provide approximately 24 or 25% ductility.

Hardnesses and ductility to be expected in weld metal

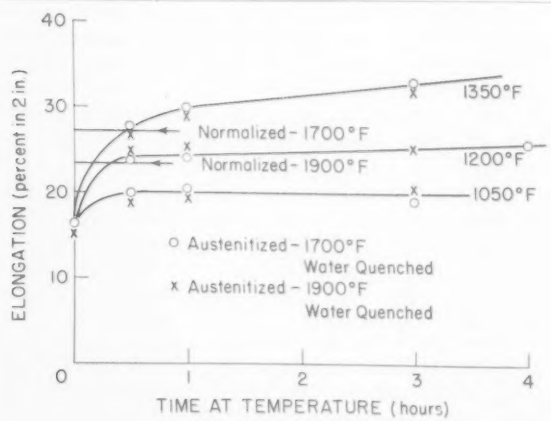
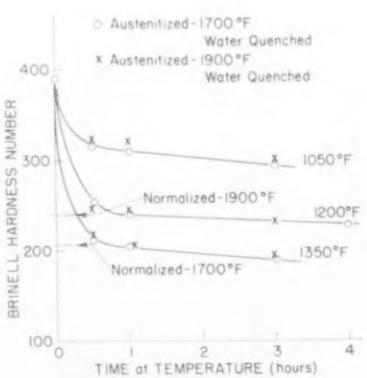


FIG. 18: Effect on ductility at several temperatures for 1¼ CrMo steel water quenched from 1,700 and 1,900 F. Fig. 19: (right) shows effect on Brinell hardness for the same alloy steel.



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and heat-affected zones are not the same as those obtained by quenching and tempering the base metal. But the base metal cooling rate during quenching is more than that encountered in the base metal heat-affected zone during welding; or, for that matter, in the weld metal deposit itself.

Figure 20 contains data for 2¼ CrMo steel which, if quenched from 1,700 or 1,900 F, gives elongation of 15 to 16%. Postheat treatment in the 1,050 F range results in a slight decrease in ductility for this alloy and may represent an aging or hardening process. When postheating at 1,200 or 1,250 F, ductilities of well over 20% are obtained, which also can be obtained with tempering or postheating times of not over an hour.

Data for Brinell hardness at various tempering or postheat treatment times and temperatures is shown in Figure 21. Again, a temperature of 1,200 F will reduce hardness to roughly 250 within half an hour. Higher temperatures will reduce hardness still more, but this is not considered necessary for weldment usability.

In many applications, it is necessary or desirable to combine some of these alloy steels. For example, a furnace may require 2¼ CrMo steel because of a temperature condition. But outside the furnace, where temperature is somewhat lower, 1¼ CrMo steel may fit the requirements.

Or, in another case, 2¼ CrMo is used at a temperature for which 1¼ CrMo weld metal strength is comparable to 2¼ CrMo base metal. Assuming that other conditions of service—corrosion or scaling resistance—would be met with the 1¼ CrMo analysis, it is preferable to match physical properties of the two as closely as possible to permit each part to take its proportionate share of the loading.

In Figure 22, ultimate strengths and elongations of 1¼ and 2¼ CrMo weld metal and 2¼ CrMo base metal are shown. These tests were made at elevated temperatures and admittedly are short-time tensile tests. However, the strength of 1¼ CrMo weld metal is higher than 2¼ CrMo weld metal or base metal.

Also ductility of 1¼ CrMo weld metal is considerably higher than 2¼ CrMo weld metal, although at higher temperatures it is somewhat below 2¼ CrMo base metal.

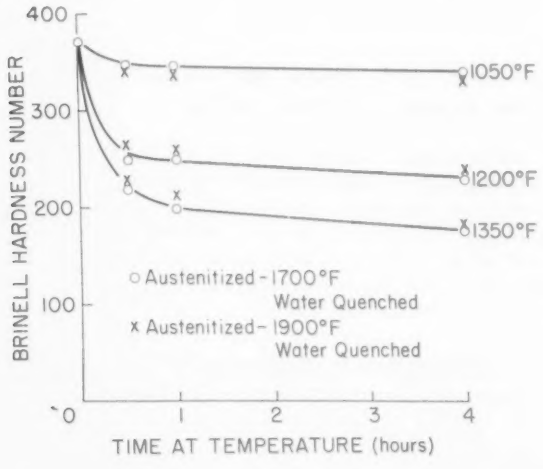


FIG. 21: Graph showing effect on Brinell hardness for 2¼ CrMo steel, water quenched from 1,700 and 1,900 F. Fig. 22: (right) shows short-time high-temperature tensile test results for 1¼ and 2¼ CrMo alloys.

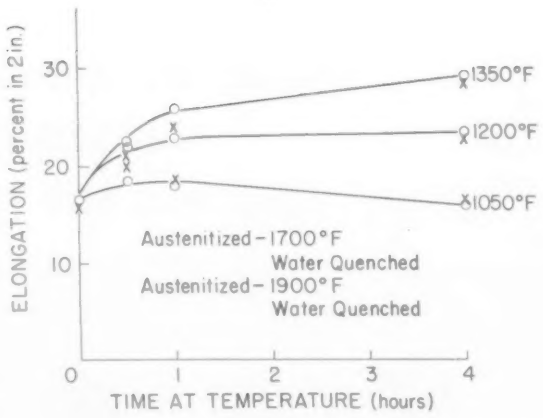


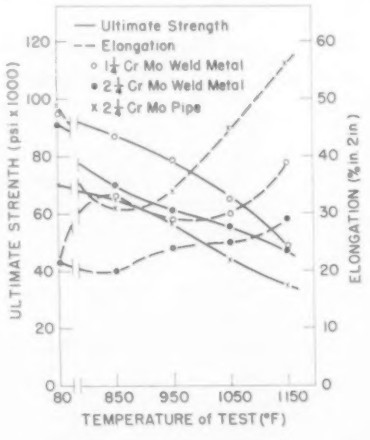
FIG. 20: Graph shows effect on ductility at several temperatures for 2¼ CrMo steel, water quenched from 1,700 and 1,900 F.

Although a 2¼ CrMo base metal heat-affected zone has adequate properties even in the as-welded condition, this is not true of 2¼ CrMo weld metal. The latter requires postheating in order to provide adequate ductility. On the other hand, 1¼ CrMo weld metal ductility in the as-welded condition is adequate and, under certain circumstances, welding 2¼ CrMo base metal with 1¼ CrMo weld metal could be a satisfactory solution.

Tests have been conducted in which the whole range of low and intermediate CrMo alloy steel castings and wrought pipe were welded with several types of filler metals, with and without preheat and without postheat. This was done to investigate the seal welding of tubes in furnace headers, using single-pass double-fillet welds under high restraint.

The 1¼ CrMo weld metal could be deposited under conditions comparable to those used for depositing austenitic stainless steel weld passes with no cracks. As long as the weld is ductile, sound, crack-free welds can be deposited. Actual hardness of base metal heat-affected zones can be discounted since this problem has been of no concern in the past.

These chromium molybdenum alloy steels are particularly important for refinery applications. Their use offers no insurmountable fabrication problems, and with intelligent approach to their material characteristics, sound and serviceable weldments can be obtained.



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a course for cadets

[*Probably the most controversial subject in America today is education. On every side, experts and would-be experts, from professors to admirals, heatedly discuss—frequently argue—the merits and shortcomings of our school system. "What can be done?" they cry. Here is what one school is doing . . . in the welding field.—Ed.*]

By Peter G. Poetto

TWO YEARS AGO a new course was offered at the New York Military Academy, Cornwall, N. Y. Subject: pre-welding engineering. It's purpose: to foster an interest in welding engineering in college-bound students.

This was not to be a class in which students squandered their time making ashtrays; prerequisites demanded one year of physics, one year of chemistry, four years of mathematics. To further insure enrolling only top-notch students, candidates were required to pass special tests.

At the first two-hour Saturday class meeting, 16 cadets were admitted; all seniors, all volunteers, all interested in engineering.

This year, at the students' insistence, the course has been lengthened to four hours. The first two hours are devoted to lectures. After lunch —at which time the cadets are given a transcript of the lecture—the final two hours are turned over to solving mathematical problems arising from the lecture.

The course itself begins by introducing students to elementary metallurgy and metallography. Once this is grasped, welding physics are undertaken. Next, the boys examine physical, chemical and mechanical metal properties, including material strength (as part of their training, the cadets are asked to compute tensile, shear and compressive stresses).

Later in the year, the course treats mild-carbon, medium-carbon and high-carbon steel: their phase diagrams, grain structure, function, and the characteristics of various carbon steel types and how these affect the metal's weldability.

Alloy steels are then presented in the same manner, with emphasis on martensitic, ferritic and austenitic stainless. At this point, non-ferrous alloys are studied. Finally, the boys approach the study of shielded-arc, inert-gas, and resistance welding.

Constant attention is given to physics and mathematics.

Because the school has no welding equipment, it is impossible for the boys to gain welding experience in the classroom. However, field trips help compensate for this deficiency. In 1957, for example, the cadets travelled one Saturday to the Avco Lycoming plant in Stratford, Conn.

Because this was to be a do-it-yourself—rather than a watch-it-yourself—tour, the boys took coveralls with them and were given welding helmets at the shop.

There were, however, demonstrations of manual metal arc and Tig welding. But these served a purpose . . . after the boys had observed welding techniques using iron-powder electrodes, they were given tacked plates and told to butt weld them.

This was comparatively simple, even for neophytes, since they worked in the downhand position and with easily-manipulated, iron-powder electrodes. Once they had laid their welds, the boys moved on to the weld testing laboratory where each ran his own tensile test and computed tensile strength, reduction of area

INTENT faces mirror students' interest in demonstration of a gamma ray camera. Pre-welding engineering course began as two hours each Saturday, was expanded to four hours, will be required of all pre-engineering students.

and percent of elongation.

Student were taught—and used—Brinell and Rockwell hardness testers. In the radiographic laboratory, they set up a weldment, watched exposure and development of an X-ray, and later read its meaning. While still at the plant, the visitors helped set up for seam and spot welding.

The course is tough. The school maintains high standards . . . the boys are treated as adults . . . *and they produce!* A great deal of homework is assigned them: each week they are expected to solve an average of 25 welding problems.

During the Easter furlough, they were given written assignments which ranged from 15,000 to 25,000 words in length. Among subjects to be considered were: *(1)* resistance welding of aluminum alloys; *(2)* radioisotopes and their use in welded pipe radiography; *(3)* inert-gas welding of stainless steel alloy, and *(4)* cost analysis of welding between weld neck flanges and slip-on flanges in pipe sizes from 2-in. schedule 40 to 80 extra-strong, to 24-in. schedule 4 to 8 extra-strong.

These subjects are not easy, nor are class standards, yet the boys seem to revel in what they are learning. Remember, it was *their* request that classes be increased to four hours.

There is, too, the example of the South American student who confessed he had studied nine straight hours for a monthly quiz, which requires a passing mark of 75%. Since taps sound at 10 p.m., the boy blacked out his window with a blanket so he could study on into the night. (Incidentally, he received 88% on his test.)

Often, boys on furlough travel many miles rather than miss their Saturday class. No student has been absent; no student has failed to turn in an assignment.

Next year the course will be divided into three phases. The first will deal exclusively with welding physics; the second with welding metallurgy, and the third with material strength and physical testing.

These will be required for all cadets enrolling in engineering colleges.

The purpose of the course is not to mass-produce technicians. It attempts to cultivate an understanding of problems inherent in welding and, if possible, to view these problems at a scholastic level comparable to that encountered in colleges.

Unfortunately, the academy is not endowed and so lacks much of the equipment necessary for carrying out all its plans. There is, for instance, a strong desire to establish a complete testing laboratory where students can explore the problems of welding research.

At any rate, the pre-welding engineering course will carry on. There is a thirst for knowledge among the students, and they are strongly attracted to the subject matter. If the demands of these young men can be met, even in part, then we will have done a great deal—primarily for them, but also for welding.

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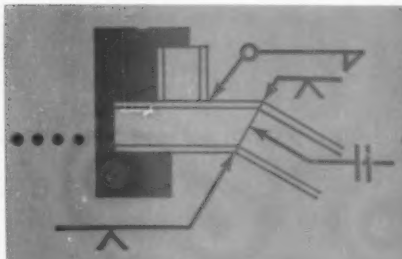

the welding clinic

Here you may find the solution to your welding problems, whether they concern design, production, construction or maintenance welding. Submit your questions for answering on this page.

Safety practices with Freon

Question:

We were using two torches to repair a refrigeration unit containing Freon-22. It ran us out twice. We finished the job using Army gas masks. The after-effects, while not disabling, have been disturbing.

Does Freon break down into toxic compounds or gases in the presence of heat? What are these gases and what treatment should be followed? After welding 39 years, I don't care to be gassed, and I don't think we missed the hospital by much.

Answer:

First of all, no refrigeration equipment or piping should ever be welded, brazed, soldered, or otherwise subjected to heat without first thoroughly evacuating the equipment.

This is an elemental safety rule, one which should be standard practice with any weldor or repairman. Any chemical material used in equipment is subject to decomposition and/or change in its chemical or physical properties when subjected to sufficient heat.

Aside from chemical decomposition, the greatest hazard involved in welding lines or equipment which have not been emptied of a refrigerant is the pressure produced with heat. All refrigerants in common use today, whether they are fluorinated hydrocarbons, or chemical compounds like ammonia, sulfur dioxide, or methyl chloride, obey the gas laws related to temperature and pressure. All will expand and increase in pressure as their temperature is raised. Naturally, if sufficient heat raises gas pressure beyond the safety limit of the container, it will break with the consequent danger of damage from shattered parts.

Welding torch flames of 1,500 F and higher will cause, with time, decomposition of refrigerants, oil, etc. The toxic hazard presented depends upon concentration of the decomposed chemicals, such as halogen acids, and the degree of confinement of the fumes, which are exceedingly irritating although they give definite warning of their presence even in small concentrations, causing people to make efforts to escape. Water streams will absorb the acids.

While much has been published over the years regarding the safety precautions to be observed in installing and servicing refrigeration equipment, there are still a few who seem to ignore or forget the basic rules of safety and, as a result, get into trouble. Remember:

(1) Wear safety goggles when working on refrigerant lines.

(2) Never weld, solder, braze or apply torches to lines containing refrigerants, oils, or other chemicals or gases.

(3) Work in well-ventilated area.

(4) Identify the materials contained in compressed gas cylinders, know their properties, and know how to handle them safely and properly.

(5) Be certain before opening lines, that they are free of pressure or any materials that may be harmful to people or cause property damage.

(6) Avoid excessive inhalation of refrigerants or other chemicals.

Because of the low toxicity and non-irritating properties of Freon refrigerants, it is not necessary to wear a gas mask when servicing refrigeration equipment. However, it is essential that protection be provided for the eyes by goggles or large-lensed spectacles to prevent liquid Freon coming in contact with the eyes and causing injury due to the freezing of the eye moisture.

Should Freon come in contact with the eyes the person suffering the injury should be taken at once to an eye specialist. Avoid rubbing or irritating the eyes and give the following first aid treatment immediately:

(1) Drops of sterile mineral oil should be introduced into the eyes an an irrigant.

(2) The eyes should then be washed if the irritation continues with one of the following:

(a) *A weak boric acid solution.*

(b) *A sterile salt solution not to exceed two percent sodium chloride.*

Should the liquid gas come in contact with the skin, the injury should be treated as though the skin has been frost-bitten or frozen.

Cases of excessive inhalation should be treated by artificial respiration, either manual or by pulmotor, and advice and treatment by a competent physician should be obtained as soon as possible.

The Editors will make every effort to answer all questions submitted to this department. If you have a question concerning welding or related processes—or a tip you would like to pass along to other readers—send it to *The Welding Clinic*.

HERE'S THE NEW

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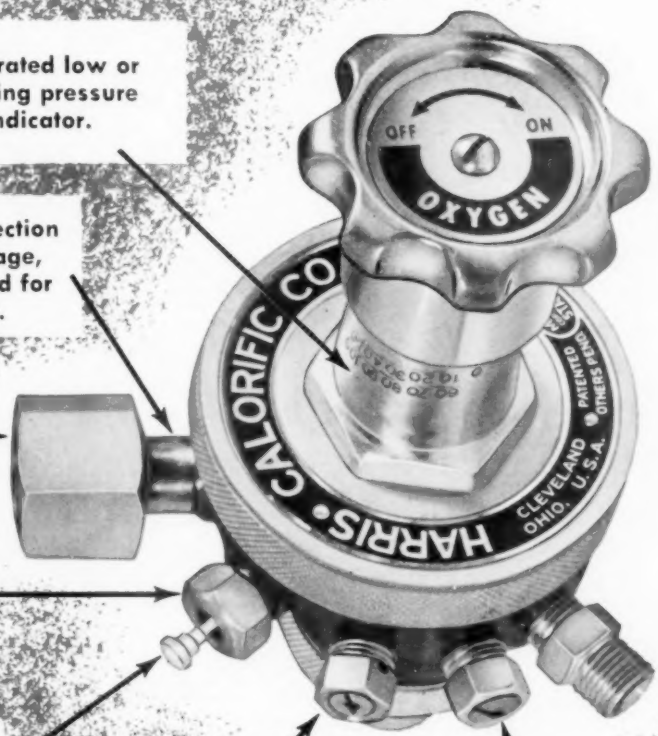

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Short inlet connection reduces breakage, readily removed for replacement.

Nut supported over inlet stem to prevent damage to stem seat.

High pressure cylinder content indicator.

Indicator showing full pressure.

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Working pressure safety valve.

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Now... here's something

really **NEW!**

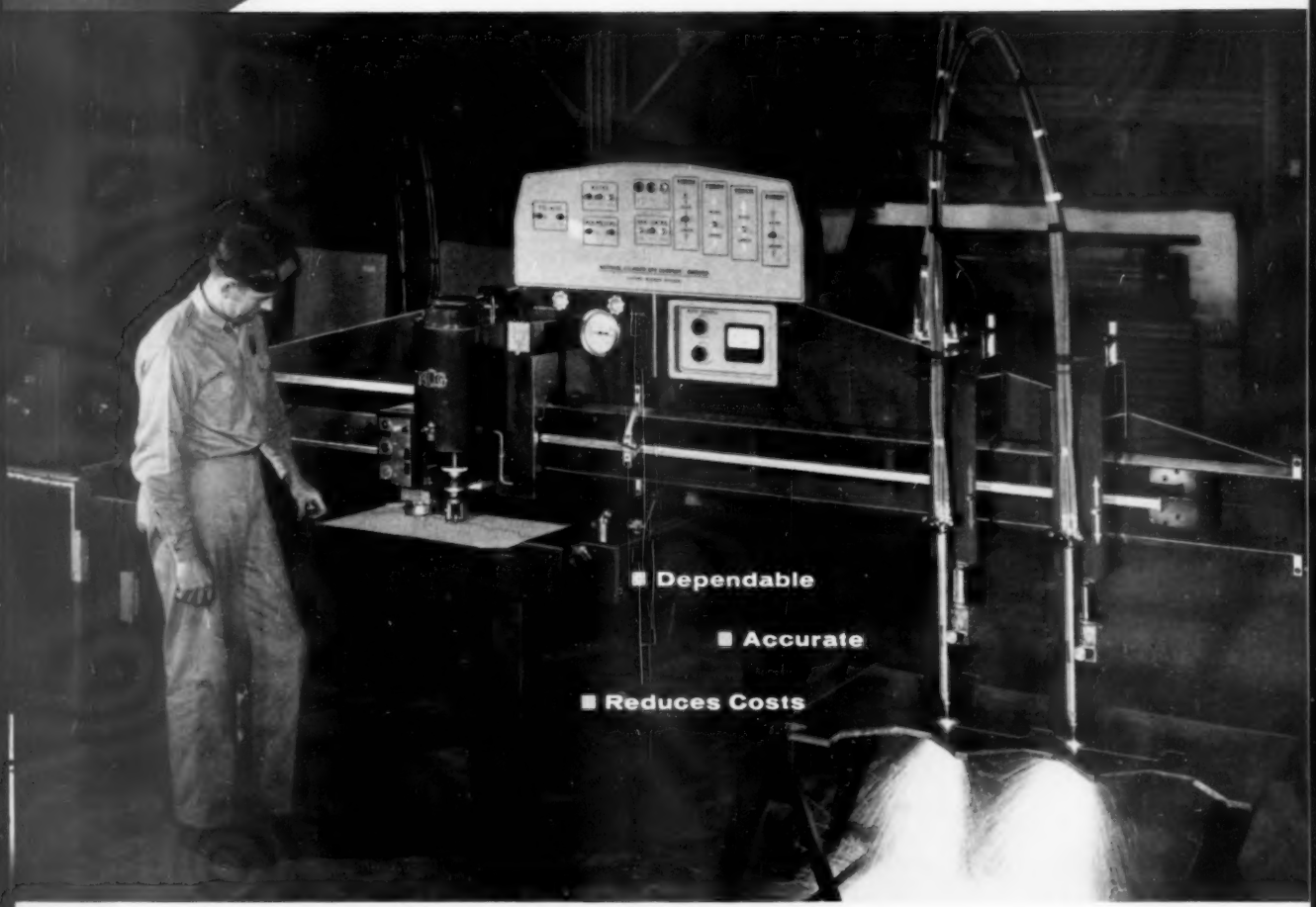
First shown in U.S.
at the 1958 American
Welding Society Show by NCG ...
the completely new

NCG®

ELECTRONIC LINE TRACER

Developed for attachment to NCG shape cutting machines, the new NCG Electronic Line Tracer controls the tracing head so it will automatically follow, with extreme accuracy, a pencil or ink line drawing of the part to be cut. Now, the tedious work of manual tracing is eliminated. In addition, the NCG Electronic Line Tracer eliminates the need for costly templets, and reduces the cost of pattern preparation at least 75% compared to other electronic systems which require more complex silhouette type patterns.

NCG Electronic Line Tracer in operation accurately following a pencil drawing. The gear cover has been removed to show the drive assembly.



NCG Type R cutting machine with Electronic Line Tracer

Principal advantages of the NCG® electronic tracing system are:

1 The NCG Electronic Line Tracer will faithfully follow a pencil or ink drawing at speeds up to 25″ per minute and execute turns on a minimum radius of 3/32 of an inch. The optical system follows the exact center of any pencil or ink line on white paper. This line may be any width up to 0.040″.

2 The NCG Electronic Line Tracer will cross lines . . . it will continue to follow the original line it is tracing even if that line crosses another providing the angle between such lines is not less than 45°. Now, drafting techniques can be developed which will cause the cutting torches to move without interruption from one cut shape to another.

3 The NCG Electronic Line Tracer is not sensitive to or affected by ambient light . . . shape cutting may be accomplished anywhere regardless of lighting conditions.

4 The NCG Electronic Line Tracer operates with ease. Manual steering directs the tracing head to the line of the drawing . . . the head follows a straight path until the line is intercepted, then the line tracer scanning system will automatically follow the line drawing.

Available now, bulletin N-142 describing in detail this sensationally new NCG Electronic Line Tracer. Call your nearest NCG office or write today.

NATIONAL CYLINDER GAS

Division of Chemetron Corporation

840 N. MICHIGAN AVE., CHICAGO 11, ILL.

CHEMETRON

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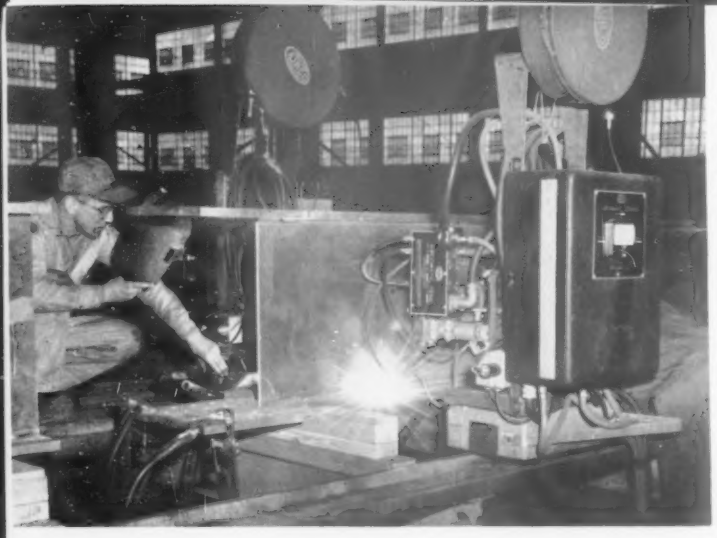


LEFT: Twin automatic Mig units make simultaneous web to flange welds on aluminum girder which serves as exterior diaphragm. Shielding gas (75% helium/25% argon) is used at 100-135 cfh; current is 260-320 amp at 27-28 volts, and welding speed is 22 ipm. Aluminum is a high-magnesium alloy.

BELOW: When semiautomatic Mig was used (here to weld splice between two girder sections) the same shielding gas was used at 80-100 cfh; current was 180-260 (and frequently kept on low side to minimize heat build-up and distortion) at 27-31 volts. Welding speed was 12-18 ipm. Totals for job included 31,964 cu ft of gas; 1,297 lb 2 oz of 1/16-in. welding wire, and 12,473½ ft of welds.

Cars will soon cross new aluminum bridge

WELDED structural members for the world's first highway bridge with aluminum girders have been shipped from Chicago to the construction site near Des Moines, Iowa. Erection is now underway.

The four-span continuous aluminum girder structure will have a reinforced concrete deck to carry traffic across a four-lane interstate express highway. It will be 222 ft long and 36 ft wide with a 30-ft roadway.

The aluminum bridge project was undertaken last winter by the Iowa State Highway Commission; Aluminum Co. of America; Kaiser Aluminum and Chemical Corp., and Reynolds Metals Co. Each participant wanted to explore potential uses of the light metal in the nation's huge highway construction program.

The welded girder system was fabricated by Pullman-Standard Car Mfg. Co., Chicago, and shipped in four big subassemblies. Each consisted of an exterior and interior girder with connecting diaphragms.

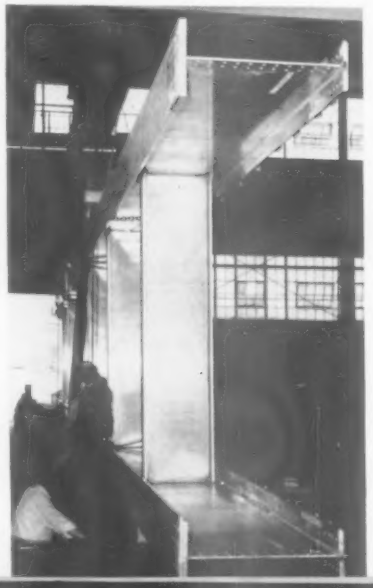
The units are about 12 ft wide and range from approximately 95 to 126 ft in length. Three railroad cars—a gondola centered between two flat cars—were required to ship each subassembly. With so few components in the field, erection is expected to be simple and fast.

Fabrication of the four structurals went smoothly, according to Pullman-Standard officials. The Mig (metal inert-gas) welding process was used, and the four longitudinal girders and connecting diaphragms were fabricated from high-strength weldable alloy plate ranging in thickness from ½ to 1¾ in.

A typical main girder has a web ½ by 36 in.; a lower flange, 1¼ by 18 in., and an upper flange, ¾ by 12 in. A typical diaphragm has a ½ by 23-in. web and 1 by 10-in. flanges.

Abutments and piers are now in place. When the girder system has been positioned and bolted, a concrete deck will be poured and installation of aluminum railings will complete the project.

BELOW: Ready for shipment to construction site is this giant subassembly, one of four needed for first highway bridge with aluminum girders. First mention of job was made on WE's "Weldworld" page in March.



Four continuous longitudinal girders spaced 9½ ft apart by diaphragms will support the roadway. The concrete deck will be tied rigidly to the girders with aluminum shear connectors to achieve composite action. The bridge is expected to be completed this month.

In addition to elimination of costly maintenance, it is anticipated that the bridge will demonstrate aluminum's structural and fabrication advantages. Project sponsors point out that aluminum offers certain structural advantages when used for members designed for composite action with concrete road slab, so a reduction in aluminum weight is permitted.

The bridge was designed by Ned L. Ashton, Iowa City consulting engineer, under the direction of the Iowa Highway Research Board and the Highway Commission. General contractors are Jensen Construction Co. and United Contractors of Des Moines.

Less than 1% rejection by X-ray

with

ATOM•ARC 7018

ALL POSITION IRON POWDER
LOW HYDROGEN ELECTRODES

AT

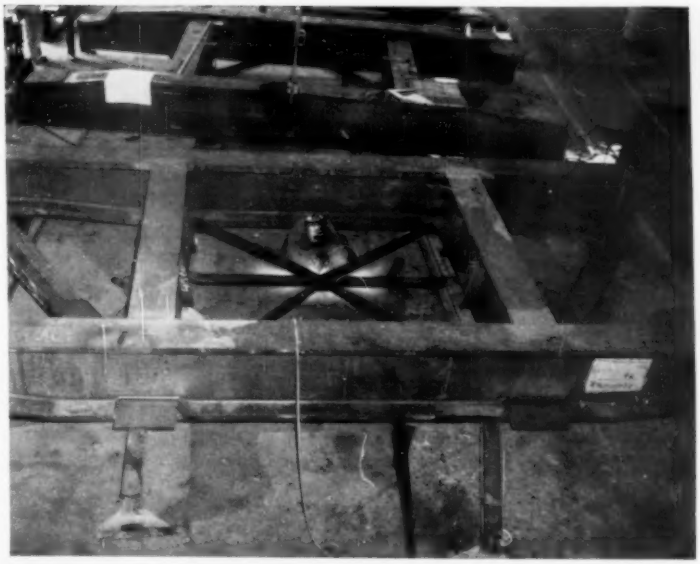
KAISER STEEL CORPORATION
Fabricating Division
Montebello, Calif.

Because of the size and weight (approx. 13.3 tons each) many of the welds were made in the vertical position.

Kaiser Steel Corporation recently completed six large missile test stands, portions of which are shown in these photographs. Except for a few minor members, the frames of these test stands were fabricated from plate material ranging in thickness from 1¼ inches to 3 inches. Atom•Arc 7018 electrodes were selected for all manual welds because of the quality of weld metal, efficiency, and out of position characteristics of this electrode.

All butt welds were required to be of radiographic quality, and in all six frames Kaiser experienced a rejection rate of less than one percent.

Atom•Arc iron powder low hydrogen electrodes for welding mild and low alloy high tensile steels have provided savings for many of the nation's leading fabricators through greater operating efficiency and superior quality weld metal.



For a complete set of data sheets write requesting Bulletin AR-8-2; Alloy Rods Company, P. O. Box 1828, York, Penna.

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Low-Hydrogen Iron-Powder Electrodes

Now even "difficult" steels can be welded right the first time—with P&H Iron-Powder Low-Hydrogen Electrodes. They permit faster welding in any position with little or no pre-heat.

Welds are free from cracks and porosity — possess superior X-ray quality and strength. Ideal for welding heavy sections subject to severe shock and abuse. Send for Bulletin R-29. Write Dept. 303B, Harnischfeger Corporation, Milwaukee 46, Wisconsin.

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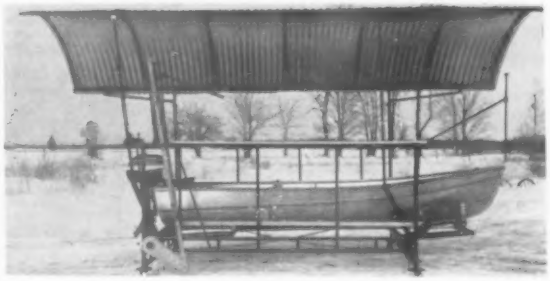

LIFT is pictured out-of-water to show how boat can be floated into position.

NEXT step is to jack boat above water to protect it from wave action and deterioration.

Boats handle easily with all-welded lift

IF YOU CAN jack up a car, you can easily lift a 1,000 lb boat out of the water. How? With an all-welded boat lift designed by Willard Smith of Northern Welding Service, Alpena, Mich.

The tubular constructed lift keeps the boat out of water when it is not in use. When the time comes for launching, a twist of the wrist releases the hydraulic valve on a jack, and the weight of the boat lowers it into the water. Since a half-ton long stroke hydraulic jack is used for the power source in the lifting operation, the unit can be used any place.

To hoist the boat above water, the lift is placed in water just deep enough for the boat to float into place. Then it is lifted to avoid wave action and water deterioration.

Most of the lift is black iron pipe varying in sizes from $\frac{3}{4}$ in. for roof support members to $2\frac{1}{2}$ in. double strength pipe for torque bars on the elevating arms. These have 2 in. pipe arms with $1\frac{1}{2}$ in. pipe cross member tying them together. Side frames and end trusses are fabricated from 1 in. black iron pipe.

The corrugated aluminum roof has support members hinged on the outboard side and fastened with a connecting rod through a lever on the torque bar of the elevating arm on the inboard (gang plank) side of the boat lift. The lever is arranged so the roof on the inboard side is elevated when the boat is in launching position. This makes it possible for passengers to get into the boat on the cat walk platform which serves as a gang plank as well as a jacking platform.

A yoke—the only flat bar stock used in the lift—is connected to the hydraulic jack and lever on the elevating arms to complete the job. The only non-welded parts are connecting pins for the required linkage and hinge joints.

This boat lift provides another good example of how welding contributes to American pleasure and ease of living.

MODIFIED roof construction provides frame for canvas roof.

New Xenon-filled Westinghouse THYRATRON TUBES IMPROVE welding equipment efficiency!

CHARACTERISTICS:
TUBE TYPE | FILAMENT Volts | FILAMENT Amps | VOLTS PEAK Inverse | VOLTS PEAK Forward | ANODE AMPS Peak | ANODE AMPS Avg. | HEIGHT | DIAMETER
WL5796 | 2.5 | 8.5 | 1500 | 1500 | 20 | 1.6 | 5½" | 1 9/16"
WL5877 | 2.5 | 10.8 | 1500 | 1500 | 40 | 3.2 | 5⅞" | 1¼"
WL5878 | 2.5 | 21 | 1500 | 1500 | 80 | 6.4 | 6⅞" | 2 3/16"
WL 5878
WL 5877
WL5796

Compact new design saves space, gives superior performance and uniform quality!

If you are designing new welding equipment, you'll find new Westinghouse Xenon-filled Thyratrons the most advanced you can use.

CHECK THESE OUTSTANDING PERFORMANCE CHARACTERISTICS:

- 12 to 1 peak to average anode current rating.
- 1,500 volt forward and inverse voltage rating.
- 15 second averaging time.
- Operate in broad ambient temperature limits (–55° to 70°C).
- Fast cathode heating time.
- Small compact construction.

These new tubes will improve performance in existing equipment, too. Check your tube complements now to find replacement applications for Westinghouse Xenon-filled Thyratrons.

DIRECT INTERCHANGEABILITY

Westinghouse Type	Replacement For
WL5796	6478
WL5877	5544, 730
WL5878	5545, 6807, C6J, 5685, C6J/K, 760, 761, 6858

To learn how Westinghouse Thyratrons can fill your welding requirements, write today for detailed data. Westinghouse engineers will be glad to consult with you, if you wish. Sample orders available for immediate shipment.

CLIP AND MAIL COUPON NOW

COMMERCIAL ENG. DEPT., ELECTRONIC TUBE DIV.
WESTINGHOUSE ELECTRIC CORP., ELMIRA, N. Y.

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☐ WL5796 ☐ WL5877 ☐ WL5878

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TITLE _____

COMPANY _____

ADDRESS _____

YOU CAN BE SURE...IF IT'S **Westinghouse** Electronic Tube Division Elmira, N. Y.

By H. O. Eads
Product Development Engineer

Easier living . . . *through welding*

WELDING REALLY got to the "seat" of the problem for one manufacturer—and this time Tig (tungsten inert-gas) welding held the solution.

In 1956 O. Ames Co. of Parkersburg, W. Va., decided to add a new line of casual furniture to its already diversified list of products (ranging from garden and farm implements to kitchen stools and high chairs).

The "Ames Aire" furniture—including chairs, tables and ottomans—had to meet the triple quality standards of strength, good appearance and modern outdoor-indoor styling, as set up by the 183-year-old company. So the problem was turned over to the Ames engineers.

The engineers selected ¾-in.-diameter steel tubing for chair and table frames. Back and seat supporting areas of the chairs were to be laced with polyvinyl chloride cord to conform to body contour.

Seat frame assembly posed the biggest problem. The tubular seat rails had to be joined to tubular cross-braces—but the resulting joint made ordinary assembly methods difficult.

Tension created by wrapping the cord on the seat rails necessitated exceptionally strong joints. On the other hand, the joint could not be so bulky that it affected appearance and styling.

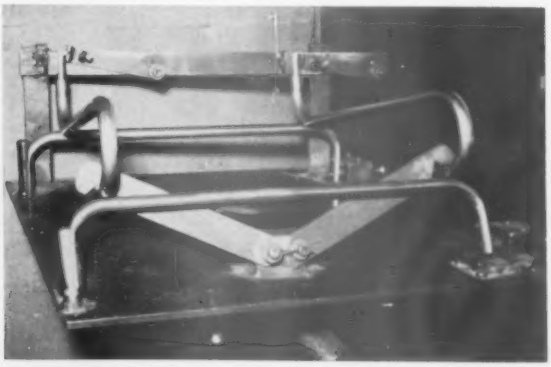
Many different methods of joining were tried: bolting did not give adequate strength and head and nut protrusion was objectionable; electric welding left rough scaly welds, making cleaning and finishing an added problem.

The answer was tungsten inert-gas welding, which gave smooth, slag-free welds, as well as strength.

The electrode could be worked into the difficult joint to obtain the necessary penetration for strength without burn-through. And when properly set up, cost factors compared favorably with other methods.

But even after the proper welding process was determined, there still remained the problem of selecting the proper welding equipment, apparatus and fixtures. Separate tacking and welding fixtures were first constructed which permitted accurate positioning of the seat frames for tack welding and greater freedom of movement for the weldor during final welding.

To meet the high production requirements, an air-cooled, 150-amp, inert-gas torch was selected instead of a heavier and more cumbersome water-cooled Tig torch. Combination flowmeter and regulators were used



SPECIAL fixture for tack welding permitted accurate positioning of the seat frame prior to final welding. Tubing chosen for all furniture frames was ¾-in.-diameter steel.

FINAL welding of seat frame was done on special fixture which allows the weldor greater freedom of movement. Frame was Tig welded with phosphor-bronze filler rod.

Low Temperature EUTECTIC WELDING ALLOYS

Plant, Research Laboratory and World Headquarters

HISTORY OF "EUTECTIC LOW TEMPERATURE WELDING ALLOYS"®

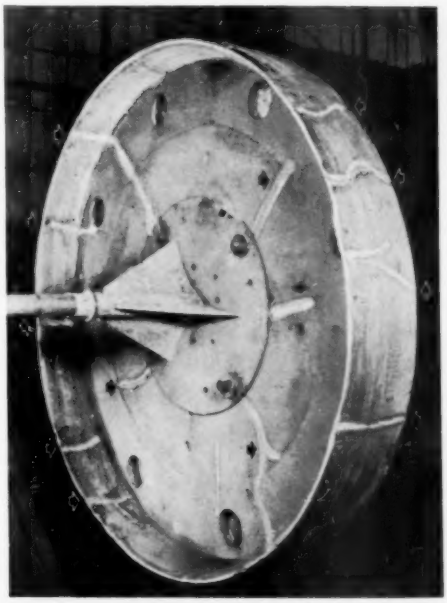
Surface alloying at low heat was first discovered by "Eutectic" in 1904 – used today in over 100,000 plants. "Eutectic" is the originator and sole manufacturer of "Eutectic Low Temperature Welding Alloys" for bonding metals at low heat, minimizing distortion, warping and stress.

EUTECTIC Welding News

PUBLISHED BY EUTECTIC WELDING ALLOYS CORPORATION, 40-40 172 STREET, FLUSHING 58, NEW YORK, N. Y.

EUTECTIC 'LOW TEMPERATURE WELDING ALLOYS'® FORMULATED FOR 'LOW HEAT INPUT' BONDING OF ALL METALS INCREASE SAVINGS BY SALVAGE AND REPAIR, SOLVE PRODUCTION PROBLEMS

5 MONTH "DOWN TIME" AVOIDED... COSTS CUT 66%



This pulverizer intermediate ring, used by a cement company, cracked in operation. Replacement posed a difficult and time consuming problem. Obtaining a new ring would have kept the pulverizer out of operation for at least five months.

In spite of the fact that the ring rotates at high speeds and is subject to the shock of impact from heavy steel balls bouncing around and abrasive wear while grinding shale, it was decided to try welding the damaged part.

One of the special problems in connection with repair was that the ring was made of alloy steel and cutting out the cracks became a special job in itself. A cutting torch did not remove metal quickly enough and the high heat involved had a tendency to cause additional cracks and fissures. Grinding wheels were considered, but this would have taken a great deal of time and the tough alloy steel raised havoc with these grinding wheels.

A special oxygenless cutting electrode ChamferTrode was used to gouge out the cracks. This method resulted in extremely rapid removal of the unwanted metal in the area to be welded.

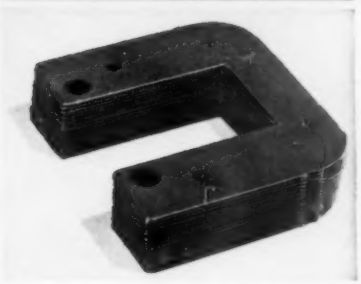
EutecTrode 680 AC-DC was used for the filling operation. This is an extra-high strength, Low Amp electrode, used where embrittlement must be avoided. It provides an ideal hard overlay cushion. EutecTrode 680 AC-DC permits quality welding on pressure vessels, dies, tools and has also seen wide use in rebuilding chemical agitator blades and shafts.

EutecTrode 680 AC-DC also has a "Frigid-Arc" coating — allows smooth, porosity-free dense deposits without spatter, and with exceptional freedom from cracking. Welds are easily deposited at the highest possible speed with least amount of base metal heat, using lowest possible amperage. The ultimate tensile strength, up to 120,000 psi.

Once the pulverizer ring was prepared and readied, weld deposits were completed, then ground flush with the rest of the ring. The mill was then put back into continuous operation with the repaired ring and has operated perfectly in spite of the heavy continuous punishment this part receives.

Materials for the repair were less than 1/5 the replacement cost, and the mill was back in full production in less than three days.

EUTEC-SILWELD 1618 PROVIDES SILVER LINING



A substantial saving was made by a transformer fabricator in laminating coils with paste-on form, silver content alloy, Eutec-Silweld 1618. The paste form eliminated unnecessary handling and waste in replacement of solder strip, and proved considerably faster in application.

Production of Eutec-Silweld 1618 in paste form partially explained its lower heat input. The minute silver particles suspended in flux melt and flow faster than solid silver. It joins at heat input as much as 150°F. less than required for conventional silver brazing material, and the lowest heat range possible for silver content alloys.

In this transformer application, the unusually low bonding temperature with Eutec-Silweld 1618 not only foreshortened induction heat cycle time, but virtually eliminated rejects caused by conventional high heat welding materials.

EutecTrode 680 AC-DC, available in 3/32", 1/8", 5/32", & 3/16" dia. Lt. Blue Tip. Standard weight shipments. • **Eutec-Silweld 1618,** packaged in 8 oz., 1 & 2 lb. jars.

FREE!
180 PAGE WELDING DATA BOOK
Invaluable procedures and theory of welding practice on all metals.

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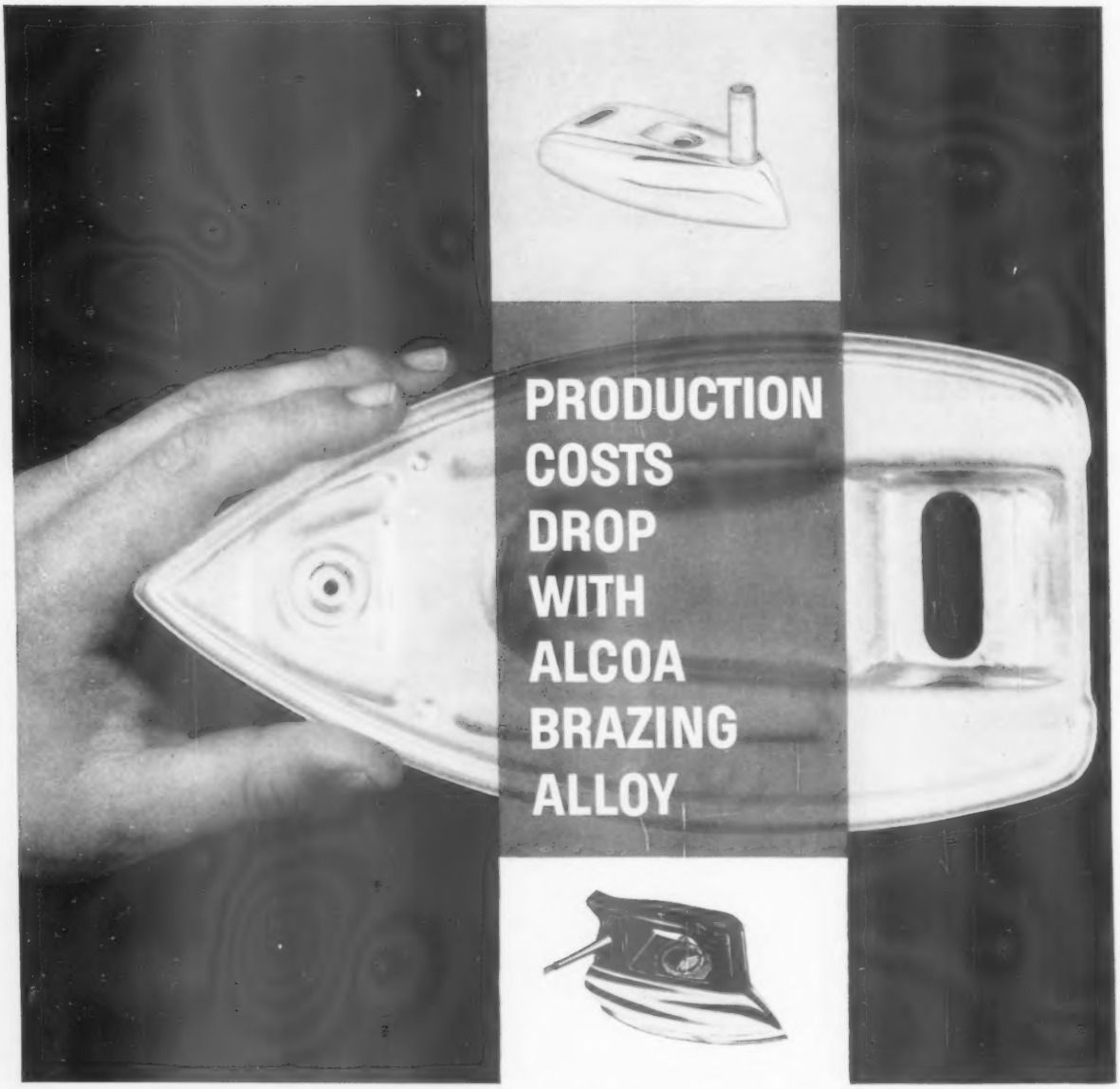

Customers get Better Steam Iron and Save $2

When Dominion Electric Company changed from silver-brazed brass to Alcoa® Aluminum in the manufacture of their steam iron tanks, they slashed material costs, simplified and speeded up production. The switch to aluminum and resultant savings in production costs meant an 11 per cent reduction in retail selling price and a better buy for the consumer's money.

To get these production savings, Dominion decided to assemble the tank by furnace brazing rather than welding. For the tank bottom, they used new alclad No. 100 Brazing Sheet with a special inner cladding of alloy 7072 to protect the core metal against penetration. No. 718 Brazing Alloy, in the form of shims or flattened wire, was used to join other parts of the tank assembly. Five components are furnace-brazed in *one single operation.*

Dominion's aluminum tank is equal in rigidity to stainless steel, more rigid than brass, yet weighs and costs only half as much as the other two materials. Hand application of filler metal and expensive chrome plating were eliminated in the switch to aluminum, and rejects are now few and far between. The new Dominion steam iron is lighter, heats faster, offers better protection against corrosion and tank perforation.

Alcoa is a never-ending source of *new and better* ways to weld, braze and solder aluminum. Write for FREE books and films on joining aluminum. Find out how aluminum can help you cut production costs and improve your product. For more information, contact one of the Alcoa distributors listed here, or write Aluminum Company of America, 1740-H Alcoa Building, Pittsburgh 19, Pennsylvania.

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Want technical help in welding, brazing or soldering aluminum? Contact your Alcoa sales office, listed under "Aluminum" in the Yellow Pages of your phone book.

For immediate delivery of Alcoa welding products, call your Alcoa outlet listed below. He carries a complete range of alloys and sizes.

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WISCONSIN
Milwaukee
Machinery & Welder Corp.
Steel Sales Corp.

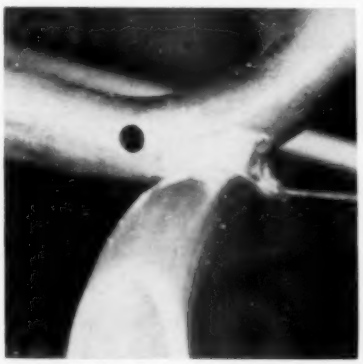
on the argon tanks to save time when changing cylinders.

A 1% thoriated-tungsten electrode gave good current-carrying capacity and starting characteristics, as well as good arc stability. The added thoria increased electronic emission and provided good melt resistance and better results on low currents.

The filler rod chosen was a special free-flowing phosphor-bronze with high tensile strength. The filler metal solidified quickly, required no flux and produced practically no slag.

An a-c/d-c rectifier type welder was used at straight polarity d-c, however, a high frequency a-c unit created the arc as the electrode approached the work. This eliminated scratching to strike an arc, as well as dead shorts, pecking and sticking.

Three welding ranges with fine settings within each range were used.



FINISHED joint was smooth and slag-free, and had adequate strength to stand tension of wrapping cord.

Medium range was from 60 to 210 amp. With the fine adjustment at 45%, approximately 128 amp were provided for welding.

The soft start feature allowed the weldor to start the arc at 60 amp and build up to 128 in approximately one second. In this manner he could direct the arc into the welding area before full heat was present.

When the arc was broken, the welder automatically turned off and a time-delay relay shut off the gas flow after 8 seconds. This delay permitted argon to flow over the tungsten until it cooled to a black hot, and kept argon consumption to a minimum.

This is another in the long list of examples of how welding can add quality, strength and appearance to modern consumer products.

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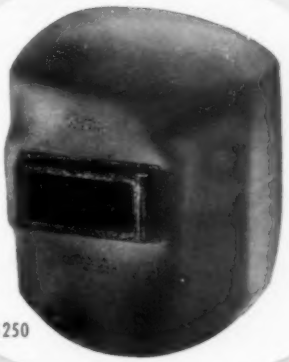

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Honeycomb gets new brazing method

By Robert B. Stanton

EXCEPTIONALLY LIGHT, stainless steel panels which can withstand operating temperatures above 1,000 F are now being produced with the help of a new brazing technique at the Fort Worth plant of the Convair division of General Dynamics Corp.

The panels are formed of foil-type honeycomb cores, ultra-thin sheet facings and edge bands. All are 17-7PH stainless.

Before the new method was developed, such laminates could not be used where operating temperatures exceeded 300 F. Conventional brazing techniques were unsatisfactory for many reasons. For example: copper brazing at 2,000 F in dissociated ammonia resulted in intergranular penetration of thin sheet laminate by cupric materials. Excessively brittle panels were yielded when a Ni-Cr-B alloy was brazed in a dry-hydrogen atmosphere.

After exhaustive tests, Convair worked out a process permitting use of a 85% silver and 15% manganese sheet alloy. Not only does this alloy have excellent flow properties and filleting action but also it retains about 60% of its room-temperature shear strength at 900 F.

But to make full use of the Ag-Mn alloy, entirely new brazing fixtures had to be developed. These were to be of high-grade graphite rather than of steel in order to maintain close dimensional tolerances. Although highly heat resistant, graphite is easily cut or machined into parts having numerous configurations.

However, graphite seemed to inhibit brazing alloy flow and caused objectionable carburization of 17-7PH materials in a dry-hydrogen atmosphere. For this reason, a —200 F dewpoint, dry-argon atmosphere was employed and the graphite and panel surfaces were separated with thin cover sheets.

Another problem solved by Convair was that of sheet widths—it proved impossible to purchase stainless wide enough for the units to be produced. This was overcome by butt welding relatively narrow widths with Tig (tungsten inert-gas) equipment.

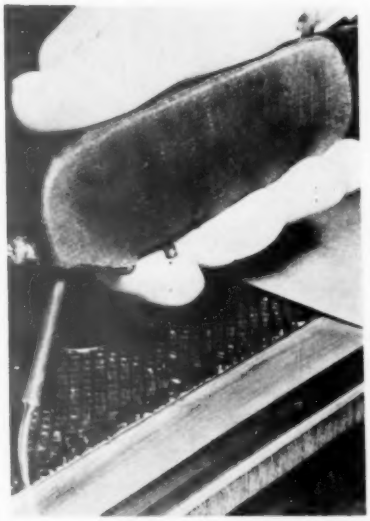
No filler metal is added to these joints because it might cause excessively thick weld beads. Instead, sheets (which are sheared to very close tolerances) are aligned, and held by a rigid clamping device. During the welding process, the upper surfaces of heated material are protected by argon and lower surfaces by helium.

Welds are then planished to remove ripples and to provide a smooth brazing surface. As an added precaution, welds are X-rayed for cracks, porosity, bead thinning or buildup. If they are destined for fabricating contoured panels, the facing materials are stretch-formed on plastic dies.

Before the honeycomb core material is used it must be inspected for quality.

Rigidity in transverse and parallel directions is a critical factor in core material. To get it, each accepted piece of stock goes through a closely controlled process.

First, it is secured to a steel platen by a sodium silicate adhesive. This adhesive is rapidly dried on a steam table while bond strength is obtained by maintaining contact between honeycomb and platen by weights placed on them.



TRIGGER-operated electric brazing gun is used here to tack weld honeycomb to laminate.

Next, the platen-mounted honeycomb is positioned on a special vacuum bed so it can be cut to specifications. This is done by a horizontal steel blade, which turns at 3,600 rpm to maintain cutting speeds from 5 ipm to 15 ipm.

A lubricant enables the cutter to produce smooth, burr-free surfaces with close tolerance ($\pm$0.003 in. being the greatest gap for capillary attraction, which permits the brazing alloy to form fillets).

After the cutting operation, honeycombs are immersed in hot water to dissolve the bonding adhesive and release the platen. They are then air dried and packaged until needed for assembly into laminates.

But before actual assembly can begin, brazing materials and laminate must be degreased and acid-etched to remove surface contaminants. So precise is the work to follow that the oil in a fingerprint would cause an area not to be brazed. From this point on, therefore, workers must handle all components with either clean cloths or rubber gloves.

To assure close brazing tolerances, the laminate's edge members are prefitted to assembly fixtures. Cores for wedge-shaped or contoured parts are used to check prefit dimensions and contour accuracy.

Core, edge and facing components are temporarily assembled by

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P&H WELDERS • ELECTRODES • POSITIONERS

being tacked to brazing materials with a trigger-operated brazing gun. An anti-brazing compound is applied to any area where Ag-Mn adhesion would be undesirable.

The graphite fixture to which the tacked assemblies are now moved is fitted with stainless steel retainers having the general configurations of the parts to be brazed. Retainers are designed so they allow an 0.005 in. increase in all laminated dimensions during the furnace heating to follow.

A small sample of 17-PH is placed on top of each assembly before its brazing fixture is sealed. This will provide material that can be machined into tensile specimens for destructive tests. In this way the assembly's mechanical properties can be evaluated.

Sealing is done by welding a thin stainless diaphragm, or "cover sheet," to the upper edges of its metal retainer. Because it is flexible enough to deflect and press evenly on a panel when a vacuum is applied, the diaphragm maintains a desired configuration by holding laminate in close contact with a graphite reference tool.

Sealed brazing fixtures are loaded into a furnace retort, which has packed-gland openings along the lower door edge for thermocouple wires, argon, and vacuum lines for use when heating is done.

After the retort is moved into a furnace, the panel assembly temperature is raised to slightly more than 1,800 F for 15 minutes (during which time the brazing alloy has ample opportunity to flow).

Austenite must be transformed to martensite. Therefore the assembly is cooled to 1,400 F and held here for 1½ hours.

The retort then enters a cooling chamber. Assembly temperatures are again reduced—first, to 400 F and then to —20 F. This completes the transformation. Thereafter, the panel assembly is hardened to the TH-1050 condition by heating it to 1,050 F.

The test specimens will be considered satisfactory if they show a tensile yield of 150,000 psi, a tensile ultimate of 180,00 psi and enough ductility for 4% elongation.

Complete radiographic examinations are given all panels. These will reveal any internal flaws like unbrazed areas, gaps between core and edge members, and core ribbon separations.

Service conditions to which assemblies are subjected; namely, high-temperature tensile and shearing stresses, are simulated by heat flashing brazed components to more than 1,000 F at a rate of 600 F per second. As yet, such testing has found no failures.

Convair's new brazing process is being used to make supersonic, delta-wing aircraft trailing edges, control surfaces and engine-nacelle panels. Although the same structures could be produced by other methods, they would have the disadvantage of being much heavier.

Honeycomb panels for trim, too

THIS PRETTY TYPIST must be smiling because she knows the slab of honeycomb panel on which she is sitting is strong enough to hold her and her equipment, yet light enough to carry about whenever she decides to do her work perched on three chairs.

A typical 1-in. panel like this one weighs only about ¾ lb per sq ft and will be used for partitions, ceilings, tabletops, and closet doors in passenger sections of Boeing Airplane Co.'s 707 and 720 jet airliners.

Instead of bonding metal honeycomb between metal sheets Boeing uses paper and fiberglas! The paper honeycomb is placed on two fiberglas sheets with a special bonding material and the resulting "sandwich" is subjected to heat and vacuum to form a complete panel.

Wooden plugs are spaced between the sheets to be used as supports for supplementary equipment like coat racks, shelves and ashtrays.

Produce "Proof-Test" Weldments at Lower Cost

Increase Welding Markets – Simple 4-Point Program

The designer, buyer or user of welded fabrications usually asks for just two things: dependable, consistent quality, delivered at a fair price.

Our Magnaflux 4-point Program helps you to give him both—at a substantially increased operating profit! It has proved that it can increase the number and types of welded components used in all manner of products. Specifically, here is what it can do for you:

1. Improve welding design

Use Stresscoat Brittle Coatings as a stress analysis shortcut, to help design easier-to-produce, more economical welded parts. You'll eliminate guesswork and wasted effort — save money and assure a fabrication right for its job.

2. Establish consistent standards

Know the service requirements you are "shooting" for. Then set the standard of quality that will meet them. This does *not* mean an abstract, costly goal of perfection. Magnaflux Test Methods find all defects in welds that *need to be found* — easily and quickly — in both ferrous and nonferrous metals . . . at any level of sensitivity *you* require.

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With Magnaflux Test Systems you have a continuous check from stringer bead to finished product. You can spot trouble fast and correct its cause. On multiple pass welds, finding defects at the first pass saves needless waste of money, saves time spent in completing welds certain to be rejected later. This increases productivity!

4. Promote the reputation and acceptance of your weldments

"Tested by Magnaflux" certifies that your welded fabrications are fully reliable for the service for which intended. This recognition helps to create new uses and markets for welded fabrications. It also helps *your own* engineers to design functionally better products at lower cost.

Why not decide now to get the whole story of the Magnaflux 4-Point Test Program — and how it can help you to tap new markets, reduce waste and increase profits. Ask to have your Magnaflux Field Engineer give you the facts, as they apply to your own operation. Write or call for a meeting. No obligation, of course — *but a strong likelihood of better earnings for your company.*

3 Tools for Better, More Profitable Welding — by Magnaflux

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The Hallmark of Quality in nondestructive test systems

This message is for men who are vitally concerned with such welding problems as maintaining a smooth flow of production... preventing excessive rejects... and insuring trouble-free, economical, profitable operation

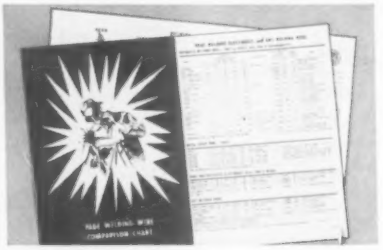
Welding Wire: Cost-saving and Profit Factors

Production men who are conscious of *both cost and quality* agree that a top-grade weld demands the *right* welding wire. *Only* by using wire with an analysis suited to the material to be welded can consistently sound welds—free from porosity and internal cracks—be produced. Use of the right wire means fewer rejects, less waste, lower costs—plus a better finished part or product.

Experienced welding men have long found PAGE a most reliable source of welding wire for all their regular and special needs. The wide range of PAGE analyses—33 of them—makes it possible to select the exact wire that produces the kind of welds that lower production costs and increase profits.

PAGE experience, talents and facilities are available to you at all times. We have been exclusive wiremaking specialists for more than half a century, and are in an ideal position to furnish our customers with the right wire for each specific need. Furthermore, we have developed a broad packaging program which saves time and money by supplying wire packaged to meet any requirement.

These factors, plus PAGE'S nationwide set-up of conveniently-located distributors, backed up by PAGE warehouse stocks, help make it profitable for you to standardize on PAGE Welding Wire.



Write for—Welding Wire **Comparison Chart DH-1218** (shown above). This highly informative, four-page chart lists detailed analyses of PAGE automatic welding wires, metal spray wires, bare electrodes and gas welding rods. Also shows uses and physical properties, including: tensile strength, elongation, Rockwell hardness. Chart lists virtually all competitive makes.

•

***NOTE** • Look to PAGE, not only for automatic welding wire, but for gas welding rods, bare electrodes, metal spray wire*

• • •

Write for—Submerged arc and inert gas welding wire **Folder DH-402A**... also gas welding rod **Booklet DH-1277.**

drum... ready to be smoothly unreeled to the welding head for automatic or semi-automatic welding! Eliminates costly machine down-time for coil replacement. Payoffpaks come in three sizes: 20" diameter (holds 250 or 500 lbs.); 23" diameter (holds up to 700 lbs.).

• • •

Write for—**PAGE Welding Wire Packaging Chart.** • This useful chart shows the many kinds of packaging of PAGE Welding Wires for each type of welding.

PAGE offers— 33 ANALYSES ...the right analysis for your welding job

There are *33 different analyses* in the PAGE line, covering the broadest range of applications: submerged arc... inert gas ...tungsten or metal arc... oxy-acetylene gas welding.

For example—

ANALYSIS A-S-30... for CO_2 gas shielded welding. Contains up to .75% of aluminum, the best deoxidizer. This, with other deoxidizing agents, liberates all gaseous impurities, and results in weld metal free of porosity, exceptionally clean, and with high physical properties. A-S-30 costs a little more—but is well worth it!

For example—

ANALYSIS A-S-NAX-9115... a low-alloy wire (with approximately .60% chromium and .10% zirconium), designed for use with inert gas, submerged arc or acetylene gas. It has high tensile strength, hardness and fine grain structure without porosity. It is the only wire to use on the NAX line of steel plates and castings.

PAGE offers— Packaging to meet your needs

PAGE Welding Wires are packaged in a wide variety of ways—for the most complete protection and the utmost convenience in handling, in stocking and in use. Here are some major types of PAGE packaging:

1. **Paper-wrapped Coils**
2. **Coils in Cartons, Palletized**
3. **Bare Coils (packed in Leverpaks)**
4. **Masonite Reels**
5. **Payoffpaks**
6. **Payoffpallets**
7. **Gas Rods in Burlap-wrapped Bundles**
8. **Stainless Gas Rods in 10-lb. Tubes**

For example—

PAYOFFPAKS... Up to 700 lbs. of wire, without a single weld... coiled around a fiberboard cylinder within a fiberboard

PAGE offers— Availability from local stocks

Here is a handy service that not only gets you the welding wire you need when you need it, but saves you money by making it unnecessary for you to tie up a sizeable investment in wire inventory.

You can get the exact PAGE automatic welding wire and welding rods your job requires direct from your nearby PAGE Distributor. Located at many points from coast to coast, PAGE distributors carry sizeable stocks for your convenience—and they are backed up by PAGE Warehouses at the strategic locations shown below. Close cooperation between PAGE distributors, PAGE warehouses and the PAGE mill is your guarantee of prompt, intelligent, individual service on your specific needs.

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AMERICAN CHAIN & CABLE

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San Francisco*, Bridgeport, Conn.
**Indicates PAGE warehouse stocks*

ACCO for Better Values

Comparison of spot welding tip areas when enlarged from original size

400% TOO SMALL (A)	PROPER NEW TIPS (B)	56% TOO LARGE (C)	125% TOO LARGE (D)	300% TOO LARGE (E)	525% TOO LARGE (F)	800% TOO LARGE (G)
APPROX. 1/81 SQ. IN. AT 1/8" DIA.	APPROX. 1/20th SQ. IN. AT 1/4" DIA.	APPROX. 1/13th SQ. IN. AT 5/16" DIA.	APPROX. 1/9th SQ. IN. AT 3/8" DIA.	APPROX. 1/5th SQ. IN. AT 1/2" DIA.	APPROX. 1/3rd SQ. IN. AT 5/8" DIA.	APPROX. 1/2 SQ. IN. AT 3/4" DIA.
2,460 AMPERE ONLY WOULD BE REQUIRED (•)	9,823 AMPERES WOULD BE REQUIRED (•)	15,337 AMPERES WOULD BE REQUIRED (•)	22,100 AMPERES WOULD BE REQUIRED (•)	39,300 AMPERES WOULD BE REQUIRED (•)	61,350 AMPERES WOULD BE REQUIRED (•)	88,500 AMPERES WOULD BE REQUIRED (•)
127,640 LBS. SQ. IN. PRESSURE (*)	31,960 LBS. SQ. IN. PRESSURE (*)	20,470 LBS. SQ. IN. PRESSURE (*)	14,200 LBS. SQ. IN. PRESSURE (*)	7,990 LBS. SQ. IN PRESSURE (*)	5,120 LBS. SQ. IN. PRESSURE (*)	3,550 LBS. SQ. IN. PRESSURE (*)
RESULT: 4 TIMES TOO MUCH PRESSURE, CURRENT. VERY SEVERE INDENTATION AND SPITTING FROM HIGH CURRENT DENSITY. **CORRECTION:** CUT PRESSURE TO ¼ CUT CURRENT TO ¼	**RESULT:** CORRECT PRESSURE, CURRENT, TIPS. EXCELLENT WELD. THIS IS THE SIZE TIP (NEW) FOR WHICH THE PRESSURE TIME AND CURRENT ARE ADJUSTED.	**RESULT:** ONLY 60% OF PROPER PRESSURE, CURRENT. BORDERLINE WELD. LOWER STRENGTH. LAST DIAMETER SIZE TOLERATED UNLESS CURRENT AND PRESSURE WERE SET BETWEEN THE ¼ AND ⅜ SIZE TIPS.	**RESULT:** ONLY 43% OF THE REQUIRED PRESSURE AND CURRENT. WELDS WOULD BE UNACCEPTABLE. IF THE CURRENT OR TIME WERE INCREASED WITH TIPS IN THIS CONDITION, A LARGE WEAK WELD WOULD RESULT.	**RESULT:** ONLY 25% OF REQUIRED CURRENT AND PRESSURE. NO WELD WOULD BE MADE IF TIPS WERE LEFT IN THIS CONDITION.	**RESULT:** ONLY 16% OF REQUIRED CURRENT AND PRESSURE. THIS IS A VERY SERIOUS CONDITION AND THE ONLY CURE IS TO DRESS THE TIPS BACK TO (B) CONDITION.	**RESULT:** ONLY 11% OF NEEDED CURRENT AND PRESSURE. THIS IS AN ABSURD (THOUGH OFTEN SEEN) CONDITION THAT ONLY HEATS A SPOT.

(•) CURRENT DENSITY REQUIRED FOR THIS GAGE TO BE 200,000 AMPS. PER SQ. IN. SETTING IS 9,900 AMPS. FOR CONDITION (B)

(*) 5" DIAMETER AIR CYLINDER A 80 LBS. AIR PRESSURE — 1570 LBS. ON RAM

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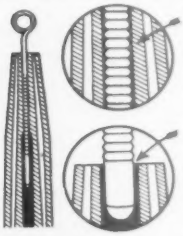

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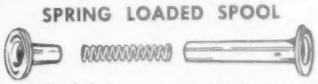

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8	73-72-71
10	70-69-68
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14	64-63-62
15	61-60
16	59-58
17	57
18	56
22	55-54
24	53-52
26	51-50-49

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30	46-45
32	44-43
34	42-41
37	40-39-38
39	37-36
42	35-34-33
44	32-31
45	30

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CLEANER NO.	FOR DRILL
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8	73-72-71
10	70-69-68
12	67-66-65
14	64-63-62
15	61-60
16	59-58
17	57
18	56
22	55-54
24	53-52
26	51-50-49
28	48-47
30	46-45
32	44-43
34	42-41
37	40-39-38
39	37-36
42	35-34-33
44	32-31
45	30

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NEW Hobart Brothers Technical School just before opening to classes.

Hobart opens new school

A PROJECT BEGUN last year was culminated a few weeks ago when the doors of the new Hobart Brothers Technical School, Troy, Ohio, were officially opened to students.

Operated on a non-profit basis, the school will be dedicated to teaching, research and development in the welding field. In the approximately 80,000 sq ft of floor space, there are 120 welding stations, sizable demonstration areas, a technical library, laboratories, research and testing facilities, an X-ray and radioisotope room, and a 400-seat auditorium with projection equipment.

The undertaking grew from the first Hobart Trade School, initiated in 1930, which has graduated 20,000 weldors to date. At the present time, only courses for weldors will be given but, as finishing touches are put on the building, a variety of technical subjects will be available. These are expected to begin by the first of the year.

Presently, 18 courses are being taught, ranging the alphabet from arc welding to X-ray testing. These are offered on a year-around basis with a new class opened every Monday. About 16 weeks are required for the average student to complete the entire arc and gas welding study, but tailor-made programs are created to meet individual requirements.

This 16-week "basic training" is the nucleus around which Hobart plans to locate more specialized courses. Such courses are designed to produce welding technicians, and will include basic electricity and metallurgy; blueprint reading, drafting, and layout; basic welding chemistry and physics; welding design; material strengths; mathematics to the level of trigonometry, and specialized welding subjects based on AWS texts. The course is expected to run from nine months to a year.

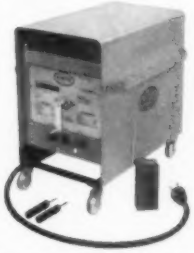
Its purpose is to fill the shortage of trained welding personnel brought on by the ever-burgeoning welding industry. Government and industrial authorities estimate there should be two to five technicians assisting a welding engineer. This figure is far from being met. The new Hobart school hopes to play some part in meeting it.

SCHOOL's gas welding section. Testing facilities are in background.

NEW — DC Aircomatic Fillerarc — motor generator type — for out-of-position Aircomatic welding and for obtaining superior welds with Pureco's welding grade CO_2. Available in 450 Ampere Model.

NEW POWER FOR WELDING

NEW—AC/DC Heliwelder—engine driven type, air cooled—for inert-gas-shielded and metallic arc welding in the field. Available in 300 Ampere Model.



NEW—AC and AC/DC MSM Busybees—transformer type—for farm, ranch, garage, shop and general low-cost utility welding. Available in 180 Ampere Model.

DC Yellow Jacket—engine driven type, liquid cooled—for heavy duty steel construction in the field. Available in 300 and 400 Ampere Models.

DC Bumblebees—Rectifier type—for general industrial welding. Available in 200, 300, 400 and 600 Ampere Models.

Behind the rise of weld-fabricated products—in manufacturing plants, on construction projects, in railroad shops, and shipyards, in thousands of small and large businesses from coast to coast—is the *power source* . . .

Air Reduction's arc welding machines are rugged, dependable, and designed to meet the power requirements of *any* arc welding job. Representative of the complete Airco line of many different power source combinations are five arc welders shown here.

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new products . . . . . USE CARD ON PAGE 97

METAL inspection unit indicates cracks and stress in welding and sub-surface defects in ferro-magnetic materials.

FLEXIBLE sheet stock is the latest form in which Nicrobraz alloys are available.

Metal inspection

To detect surface and sub-surface defects in ferro-magnetic materials, a new portable magnetic inspection device is being marketed. Unit weighs 23 lb, includes a "U" shaped, 110-volt electro magnet which operates at 0.175 kva on 110 volts. Magnetic field set up by "Ferroflux" is strong enough to lift more than the unit's weight. Also indicates tool marks and cracks and stress in bending, forming, heat-treating and welding. *Ferro Machine & Tool Co.*

Circle No. 1

X-ray film

HIGH radiographic sensitivity X-ray film is designed for inspection of thin or medium-thick sections of light metal at low and medium kv. Made for laboratory research and re-check work. *The Gevaert Co. of America, Inc.*

Circle No. 2

Spot welder

SPOT welder with built-in electric timer produces uniform welds, manufacturer says. Completely automatic, the tongs grip work at a predetermined pressure when the operating handle is pressed, the start switch is actuated and weld sequence is started. Models 110 volt or 220 volt 1.5 kva weigh 29 lb, and 220 volt 2.5 kva, 39 lb. *Miller Electric Mfg. Co.*

Circle No. 3

High tensile electrodes

JETWELD LH-90 iron powder electrode is intended for use on high temperature, high pressure piping and on steel fabrication where either a high alloy content or tensile strength is needed. Jetweld LH-110 is designed for use on HY-80 and T-1 steels, or any other steels that need high strength joints. Firm says deposits of both electrodes have good impact properties in both as-welded and stress-relieved conditions. Available in 1/8, 5/32 and 3/16 in. diameters, electrodes are said to need minimum preheat, and produce welds that are free of underbead- and micro-cracks and porosity. *Lincoln Electric Co.*

Circle No. 4

Portable welder

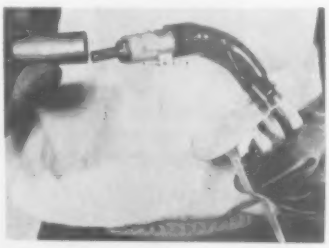
PORTABLE arc welder with dial current control has no movable coils, shunts or flux diverters. Output range is from 25 to 250 amp, and it handles electrodes from 1/16 to 3/16 in. It will weld material from sheet metal to 2-in. thick steel. Model 250C is rated at 50% duty cycle. Weighs only 112 lb, measures 12 by 13 by 15½ in. *Brennen, Bucci & Weber, Inc.*

Circle No. 5

Spatter preventive

FIRM says pleasant smelling, non-toxic, non-inflammable and non-corrosive liquid will prevent the adhesion of weld spatter to surrounding metal surface. Applied to area adjacent weld, the spatter and liquid wash away when weld is completed. *Clarkson Laboratories, Inc.*

Circle No. 6



Air-cooled gun

NEED for water hoses and connections eliminated with air-cooled gun, which increases cost-cutting potential of Mig welding using carbon dioxide shield. Firm says gun is fast, economical, inexpensive and portable. *Hobart Brothers Co.*

Circle No. 7

Brazing sheet

FIRM has brazing alloy in new form—flexible sheet stock from 0.015 to 0.060 in. thick. Nicrobraz is recommended for use in brazed laminated sections and sandwich configurations of stainless steels, high alloys and titanium. Tests show that material has flow and wetting properties equal to conventional brazing alloys. *Wall Colmonoy Corp.*

Circle No. 8

Electrode

HIGHLY-alloyed coated electrode has been designed to impart toughness, corrosion and heat resistance, says firm. Eutectrode 6800 is used in rebuilding forging dies, tongs, hooks, ladles, etc. *Eutectic Welding Alloys Corp.*

Circle No. 9

Induction heating

COMPANY has developeded new 400 cycle units that grew out of earlier rotating type heater. Applications include heat treatment of stainless and non-magnetic steels in thicknesses up to two in. and the fast heating of other materials in gages up to ⅝ in. *Electric Arc, Inc.*

Circle No. 10

Positioner

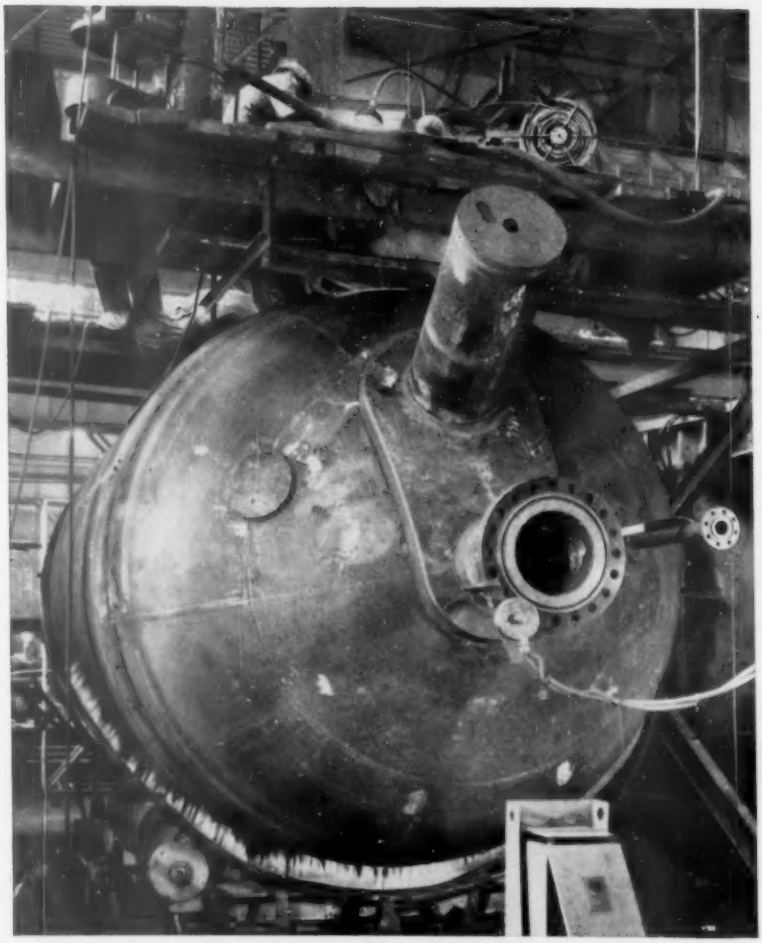
EXCALIBUR, rated at 350,000 lb, is claimed to be the highest load capacity welding positioner ever built. Four-speed gear shift transmission affords choice of rotation speeds. Top high gear speed for small jobs is .4 rpm, third gear range is .24 to .04 rpm. Large work can be done in second gear, range .13 to .023 rpm, or in low gear, range .08 to .013 rpm. Only 88 in. from floor to horizontal rotation axis, machine can handle 90% of jobs, from as small as one ton to as large as 175 tons, says manufacturer. *Aronson Machine Co.*

Circle No. 11

For any stainless welding job

SPECIFY **Drawalloy** CORPORATION

Stainless Steel Welding Wire



Spooled for Inert Gas Shielded Metal Arc Welding

Coiled for Submerged Arc Welding

Cut Lengths for Inert Arc Welding

Specify Drawalloy "quality controlled" stainless steel welding wire for *your* next "quality weldments." Your greatest advantage is experience . . . our experience in producing wires for welding exclusively. Because we are specialists, Drawalloy stainless steel welding wire is produced to strictly controlled specifications to provide the right chemistry, finish and temper for the finest quality weld metal and smoother operation in your automatic or semi-automatic equipment. Drawalloy stainless wires are available in all popular grades as well as 2¼ Cr, 1 Mo; 1¼ Cr, ½ Mo.

Why not discuss your stainless welding wire needs with your Drawalloy Distributor or Representative . . . a man with the products and knowledge to help you. Bulletin 355 DC provides complete information on every grade of Drawalloy wire. Write to: Drawalloy Corporation, Lincoln Highway West at Alloy Street, York 12, Penna.

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YOUR BEST MOVE . . . MOVE
with MERRILL
MATERIAL
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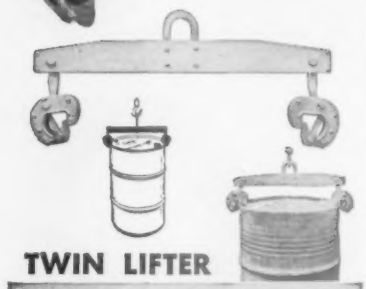
DEVICES



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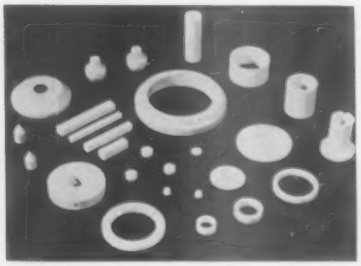


Ceramic jigs, fixtures

THERMAL changes, such as water quenching from 2,200 F, can be withstood by new pressed ceramic parts, says manufacturer. Applications include brazing locators, projection and spot welding jigs, shielded arc welding jigs, torch and furnace brazing jigs and shielded arc welding nozzles. *Duramic Products, Inc.*

Circle No. 12

Static converter

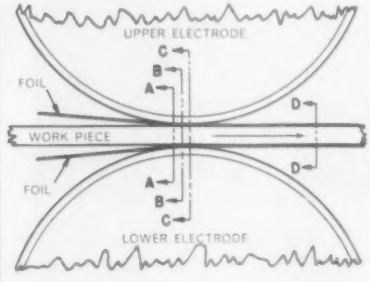
AJAX-Multiductor is power supply for many types of induction heating and melting equipment. The machine contains no rotating parts, leaving nothing to wear out. Can take three-phase power at 60 cycles from regular or primary sources and convert it to single phase power carried from converter to furnace by conventional wiring. *Ajax Electrothermic Corp.*

Circle No. 13

Spring plungers

SPRING plungers for use in positioning parts in jigs and fixtures are made of hardened steel that will not "mushroom," manufacturer says. Spring is specially treated to withstand continuous flexing without crystallization. It comes in 10 sizes from 6/32 in. to 1 in. *Jergens Tool Specialty Co.*

Circle No. 14



Foil welding

FOIL welding machines are being produced in the U. S. for first time. Firm says new machines make smooth, non-overlapping seam welds of dense structure and high strength. Speed is a feature of this machine with it having made welds on 0.078 in. stock at 3 to 24 ft a minute. Can be used for welding sides and roofs or railroad cars, automobile fenders, dairy containers, etc. *Precision Welder and Flexopress Corp.*

Circle No. 15

ALL-POSITION WELDING

is faster, easier than ever when you use new

AIRCO EASYARC 10

- Airco Easyarc 10 iron powder type electrodes are unexcelled for out-of-position welding.
- Weld tanks of galvanized or plain surfaces.
- Weld pressure vessels, fired or unfired.
- Weld steel castings, and a wide variety of machinery parts, pressure pipe, and construction steels.

• • •

Airco Easyarc 10 electrodes are used with DC reverse polarity. Produce welds of excellent shape, with minimum undercutting. Permit fast deposition and easy control of weld metal.

FREE — Send for the handy Airco Electrode Guide. It will help you select the right electrode for your specific job. Request catalog 1318.

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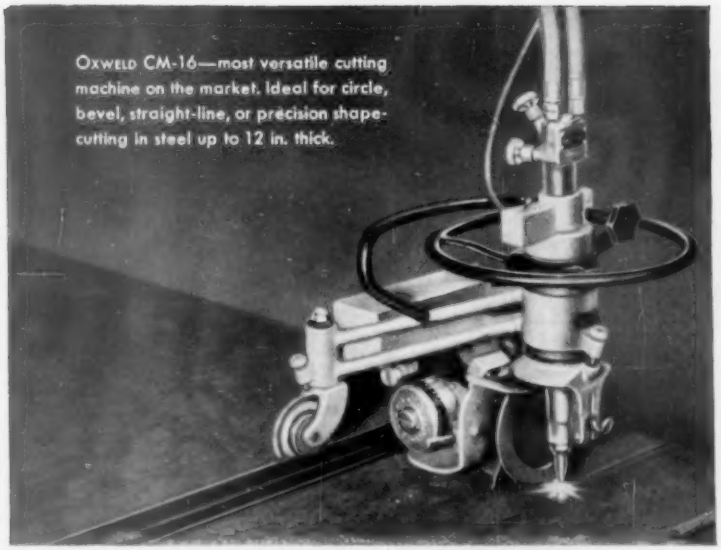
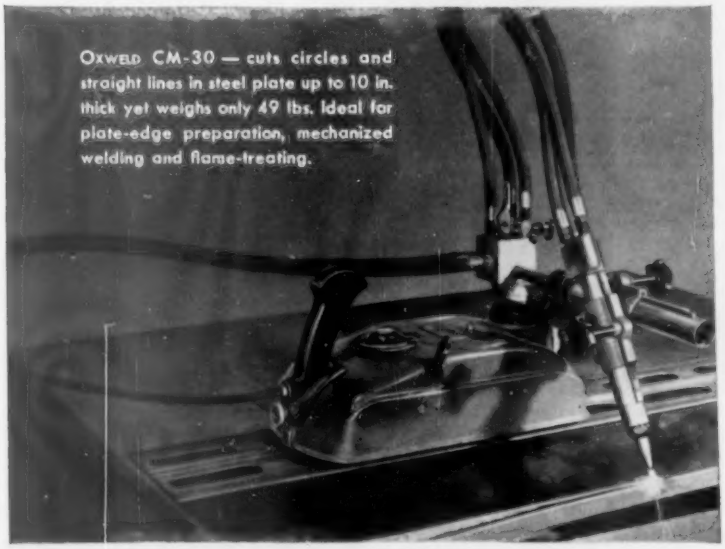
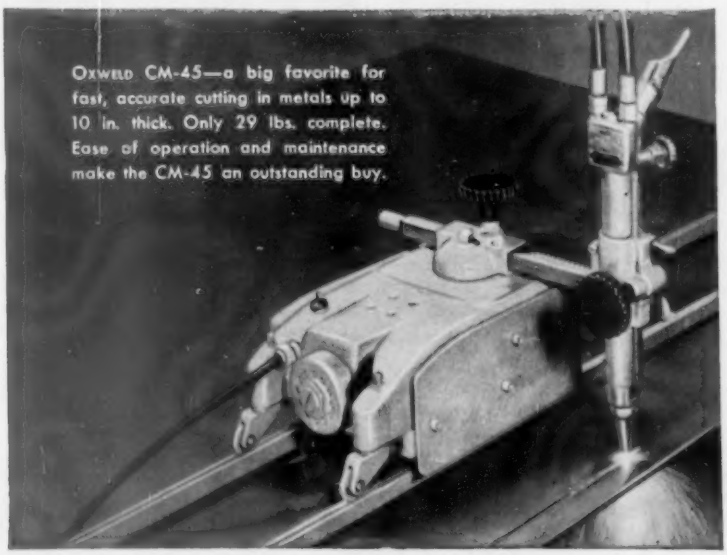


OXWELD CM-16—most versatile cutting machine on the market. Ideal for circle, bevel, straight-line, or precision shape-cutting in steel up to 12 in. thick.



OXWELD CM-30 — cuts circles and straight lines in steel plate up to 10 in. thick yet weighs only 49 lbs. Ideal for plate-edge preparation, mechanized welding and flame-treating.



OXWELD CM-45—a big favorite for fast, accurate cutting in metals up to 10 in. thick. Only 29 lbs. complete. Ease of operation and maintenance make the CM-45 an outstanding buy.

cutting holes in production costs

OXWELD

Trade-Mark

PORTABLE CUTTING MACHINES

Here's the modern, efficient way to slash maintenance and production costs —*mechanized* flame-cutting with OXWELD Portable Cutting Machines. These versatile machines offer you a matchless combination of speed, production-line accuracy, and low-cost operation — a combination that adds up to greater savings for you on every cutting job.

And like every OXWELD product, OXWELD Cutting Machines are backed by half a century of experience and know-how . . . your guarantee of peak performance and quality results.

Ask your nearby LINDE representative to show you the *complete* line of dependable OXWELD Portable Cutting Machines —or write for free catalog F-4487. Do it today!

LINDE COMPANY

DIVISION OF

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30 East 42nd Street, New York 17, N. Y.

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Oxweld
TRADE-MARK

Flux-Coated Bronze Rod SAVES TIME!

THIS triple-purpose OXWELD bronze rod is ideal for braze-welding steel, cast iron, and malleable iron; for building up wearing surfaces; and for fusion-welding brass, bronze, and copper alloys.

Welds made with OXWELD No. 25M rod average 40% stronger and are more ductile than welds made with ordinary bronze rods under similar conditions. Pre-coated during manufacture, OXWELD No. 25M Flux-Coated Rod automatically introduces into the weld exactly the right amount of flux to insure both thorough cleansing and uninterrupted tinning action. This speeds your work by permitting you to give full attention to deposit of weld metal and control of the molten puddle.

OXWELD No. 25M Flux-Coated Bronze Rod is available in 1/4-, 3/16-, and 1/8-in. diameters from your nearby LINDE Distributor. For further information write LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

Linde TRADE-MARK
UNION CARBIDE

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Power plant

ANOTHER "first" is claimed for 4-IN-1 machine that incorporates in one unit an a-c/d-c welder for (1) metallic arc, or (2) Tig welding, plus (3) a-c power plant and (4) 1 kw d-c power while welding. Six separate amperage ranges are available in both a-c and d-c. Standard equipment includes polarity switch, either continuous or "start only" high frequency, and an automatic inert-gas control panel with solenoid valve and postflow timber. Rated output at 100% cycle: 250 amp d-c tungsten arc; 300 amp a-c tugsten arc. Generator: 10 kw of 115/230 volt, single phase, 60 cycle a-c. *Miller Electric Mfg. Co.*

Circle No. 16

Torch filter

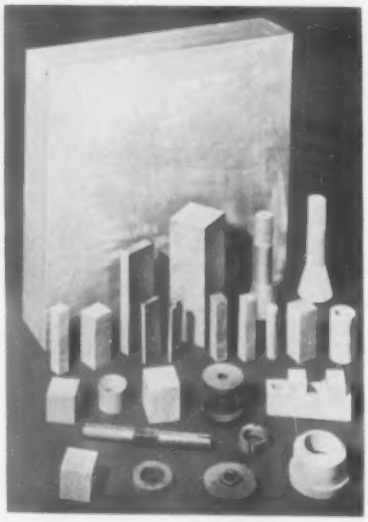
AIRCRAFT torch filter is suitable for liquid or gaseous fuels and is equally effective when used with welding, brazing or cutting torches. Special "Permetal" filter prevents particles as small as 0.001 in. from entering torch, and prevents flashback from passing through filter to hose line. *Gibbs Ltd.*

Circle No. 17

Brass valves

LINE of five forged brass high pressure valves is offered in the "Master Valve" 3,000 psi category (½ to ¾in.); the "Non-Return, Shut-off" 250 psi (1 to ½ in.) and the "Pneumatic Electric" 150 psi (1 in.). *Air Reduction Sales Co.*

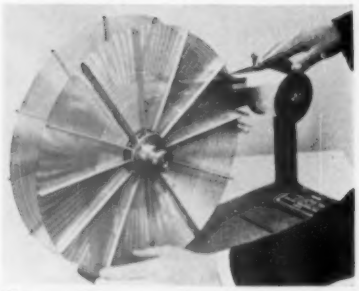
Circle No. 18



Machinable lava

For model making or experimental designs, machinable lava is available in block form. Can be fabricated into precision parts to specifications. Blocks up to 6 by 12 by 20 in. available. Physical and electrical characteristics are little changed by firing. Inert and resistant to thermal shock, lava is ideal for jigs, fixtures, support rings and work-holding devices for induction heating, brazing, welding, soldering, etc., firm says. Excess flux or solder dropped on material easily removed with wire brush. *American Lava Corp.*

Circle No. 19



X-ray film equipment

PROBLEM of developing long strips of 70mm X-ray film used for radiographing circumferential welds in pressure vessels can be solved with new film processing equipment, manufacturer says. It will handle film up to 100 ft long. Stainless steel "Nikor" setup includes reel to hold film, jig to load film onto reel and three solution tanks. To develop, put loaded reel in tank of developer and put on cover. Open framing of reel lets developer flow around film. *Picker X-Ray Corp.*

Circle No. 20

Turning roll

"REVOLUTIONARY," firm says about its new design in power turning roll equipment which eliminates use of cross or jack shafts for driving each roll. New turning roll equipment uses individual drive motor for each roll assembly on power roll. Individual drives have a-c constant speed squirrel cage motors with variable speed through use of magnetic slip couplings. Driving power from a-c, and minute amount of a-c current is converted to d-c to operate magnetic slip clutch by using small thyrotron tube. Drive mechanisms completely enclosed. *Pandjiris Weldment Co.*

Circle No. 21

Welder-compressor

SELF-propelled unit for operations requiring both arc welding current and compressed air has 125 cu ft rotary type compressor mounted on rear. Driven by a four-cylinder gasoline engine, compressor is self-contained except for drawing gasoline from common fuel tank. Welder is 600 amp d-c unit driven by a Chrysler V-8 engine. Same engine drives vehicle, through a special axle and Chrysler transmission and torque converter. Unit is equipped with hydraulic power steering. *Hobart Brothers Co.*

Circle No. 22

Safety glasses

NEW line of safety glasses includes a multi-fit bridge that is claimed fit more than 90% of all employes. Firm says special design also overcomes tendency of safety glasses to slip down on the nose *Fendall Co.*

Circle No. 23

Spot welder

MANUFACTURER says new spot welder sequence interlock permits the operation of a group of spot welders of various makes from a single line able to handle only the largest unit. When control unit is locked to a welder, other welders are prevented from firing. Firm says control works so fast that welders notice no delay in firing time, and save power through a rigid control of demand rate. *Instrument Control Co.*

Circle No. 24

Aluminum solder flux

FIRM says it has improved soldering flux for aluminum by increasing capillary action so solder can be made to flow uphill on aluminum joints. Improvement increases usefulness of aluminum solder and provides stronger joints. *Aladdin Rod and Flux Mfg. Co.*

Circle No. 25

Electrode coating

Primary use for No. 865 grade potassium silicate, a solution with water-white clarity, will be in the production of welding electrodes. The improvement in the grade of potassium silicate coincides with a recent price reduction of 50 cents per hundred weight for this grade. The new clear product can also be used in the production of paint, asbestos and liquid detergents. *E. I. Du Pont De Nemours and Co.*

Circle No. 26

Air valve

FOUR-way air valve for use with spot welders, pneumatic tools, etc., is small and can be mounted at the cylinder. Change of direction in air flow takes place in less than half a cycle at 60-cycle frequency. Also available in special enclosure for mounting directly on gun welder cylinders. *Square D Co.*

Circle No. 27

Gas welding kit

COMBINATION kit includes welding torch, tips, cutting attachment and tip, oxygen and acetylene regulators and accessories. Manufacturer says equipment is lightweight but of ample capacity for most welding, cutting, brazing, soldering or heating jobs. *National Cylinder Gas Div., Chemetron Corp.*

Circle No. 28

Your

LINDE Distributor

has it—

1. Service

Every authorized LINDE Distributor is an independent *local* businessman who knows your welding and cutting needs, has them ready for you, and satisfies you promptly.

2. Know-How

LINDE Distributors are welding supply *specialists.* Their technical background, practical experience, and knowledge of local industry can help you with your welding and cutting problems.

3. Superior Products

Your LINDE Distributor carries a *complete* line of industrial gases, equipment and supplies for your welding and cutting requirements. He handles only high-quality products of proved efficiency and best suited to your individual needs.

A telephone call to your nearby LINDE Distributor will bring you the benefits of more than 50 years of LINDE COMPANY's pioneering and leadership in welding and cutting. If you don't know your local LINDE Distributor, look in your classified telephone directory. Or write for further information to LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N.Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited, Toronto.

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UNITS AVAILABLE FROM 2 KW TO 200 KW
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Stainless electrodes

THREE new stainless steel electrodes, "Easy-arc 308, 316 and 347" are the first powdered metal stainless electrodes ever offered, manufacturer says. The a-c/d-c electrodes have a coating which contains chromium and nickel in powdered form. *Air Reduction Sales Co.*

Circle No. 29

Spring balancers

POWER tools, welders, etc., can be held up with new spring balancers. Designed to eliminate hand tool problems and to keep the shop floor clear, the balancers come in five basic types: EP15, 26 to 40 lb; EP18, 33 to 49 lb; ER22, 40 to 55 lb; ER32, 54 to 88 lb ER50, 85 to 132 lb.

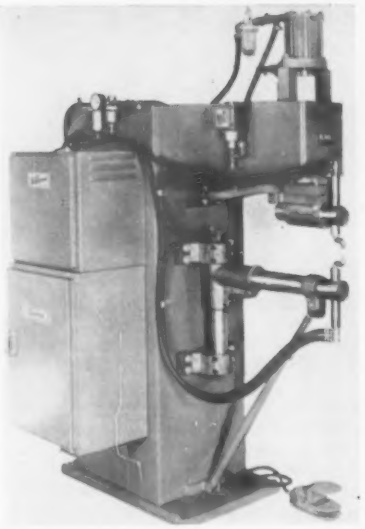
Tool remains balanced over distance of 3 to 5 ft high. At rest, tool is out of way. Load can be locked into position; an automatic built-in safety device protects tool and operator against spring rupture or accidental breakaway of load. *Aro Spot Welder Div.*

Circle No. 30

Ammeters

IMPROVED Tong Test ammeter is said to be the only instrument of its type that measures both a-c and d-c. Available in eight types and measures up to 1,000 amp, it includes heavy, strong scale range construction, insulated operating trigger and plastic handle. *Columbia Electric Mfg. Co.*

Circle No. 31



Spot welder

SPECIALLY designed for the sheet-metal, wrought-iron and wire fabricating industries, new resistance spot welder permits bind-proof precision alignment of work. Independent air valve brings ram down for fine electrode adjusting. Current capacity is 75 kva. Maximum open circuit secondary voltage is 9.15; minimum short circuit secondary amp, 8,600; minimum open secondary volts, 3.2. *Alphil Spot Welder Mfg. Corp.*

Circle No. 32

THE *NEW* MILLER
ALL-IN-ONE SPOT WELDER
for
ALL NUMBER ONE WELDS
LECTRO SPOT
Built-in Timer Turns the Trick
Sheet metal shops ready for new speed, economy and completely uniform spot welds will want the new Lectro Spot. Here's why:
Operator depresses lever and,
1 — 2 — 3:
Tongs grip work at pre-set pressure;
Starter switch is actuated;
Weld sequence starts and stops automatically;
Result: EVERY WELD IS IDENTICAL!
Pressure adjustment and electronic timer controls instantly accessible.
Three models in 115 or 230 volts weld mild steel of 1/8" to 3/16" combined thickness; 1.5 KVA weighs 29 lbs., 2.5 KVA weighs 39 lbs.
Wide choice of tongs available.
Complete information sent promptly.
miller ELECTRIC MANUFACTURING COMPANY, INC. Appleton • Wisconsin
Distributed in Canada by Canadian Liquid Air Co., Ltd., Montreal

Honeycomb sheet

Two years of research went into a new honeycomb brazing sheet 0.005 or 0.101 in. thick, for use with stainless steels, high alloys and titanium. The thin, flexible sheets are ideal for application in manufacture of brazed honeycomb structure for high temperature service, says manufacturer. New sheet is available in widths from 2 in. to 2 ft. One lb of nominal 0.005 in. honeycomb sheet will cover about 18½ sq ft of area, one lb of 0.010 in. covers about 9 sq ft. *Wall Colmonoy Corp.*

Circle No. 33

Portable welding unit

ENGINE driven welder has been designed by manufacturer to be used as a portable 150-amp d-c welding unit with the Land Rover. The L.R. 150 weighs 350 lb, has a continuous hand-welding rating of 150 amp at 30 volts, a current range of from 30 to 200 amp, 3,000 rpm, and requires a 16-hp engine to power it. Manufacturer says it can speedily weld most metals and alloys, light gage and heavy materials with either bare or coated electodes, and that it is ideal for carbon arc welding. *Lincoln Electric Co., Ltd.*

Circle No. 34

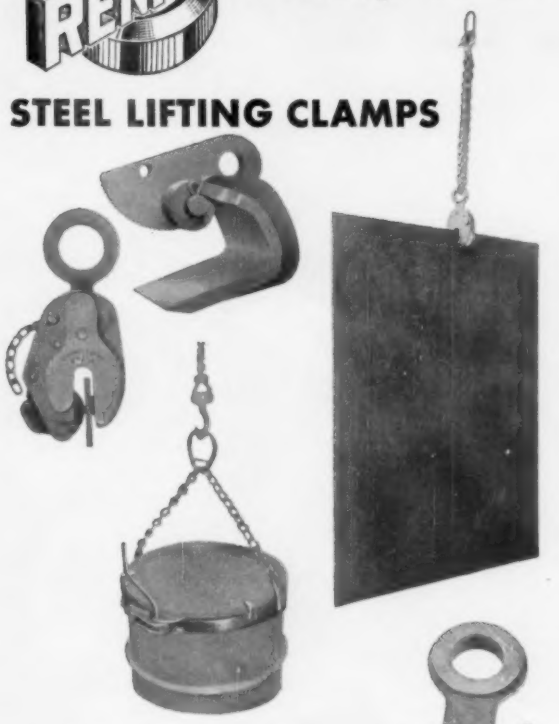
Weld positioner

"HUMAN" welding positioner even thinks for the operator, manufacturer says. The 3,000 lb capacity positioner automatically produces required welding condition for each specific job. Rotation drive and controls permit operator to quickly set rotative welding speed in ipm. Table speed, workpiece diameter, and welding speed are automatically correlated. *Pandjiris Weldment Co.*

Circle No. 35

RENFROE Safety Snap Lock

STEEL LIFTING CLAMPS



HANDLE STEEL WITH SAFETY

√ Maximum Speed and Safety
√ From ½ ton to 20 ton sizes
√ Lock on in any position
√ Lock off in any position
√ Exceptionally light in weight
√ The toughest clamp ever built
√ Takes the place of welded pad eyes and screw clamps
√ Cannot be accidentally knocked off
√ Safety Factor 5 to 1

A Superior Line of Steel Lifting Clamps designed to meet today's demand for handling steel with maximum SAFETY and EFFICIENCY.

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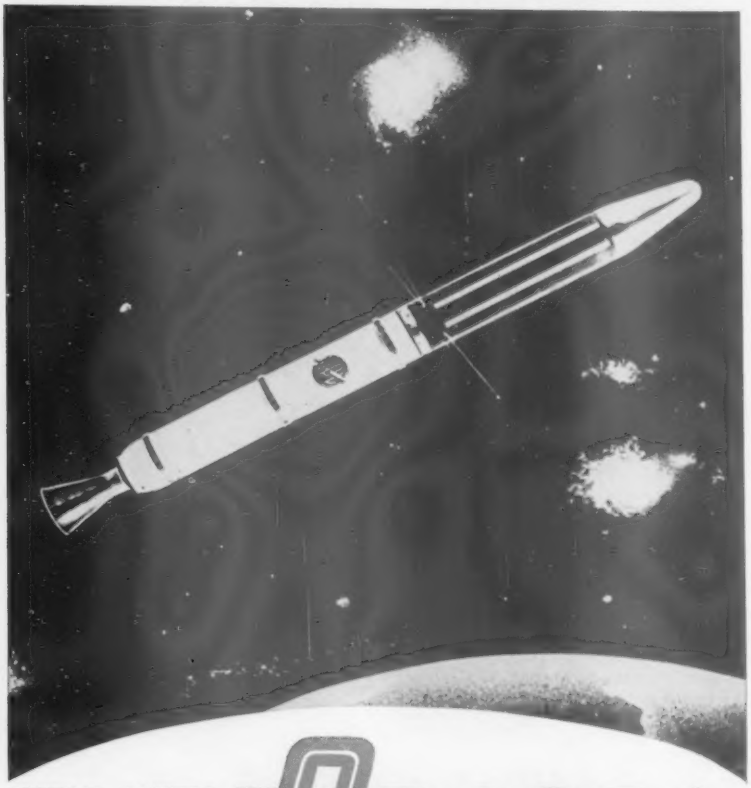
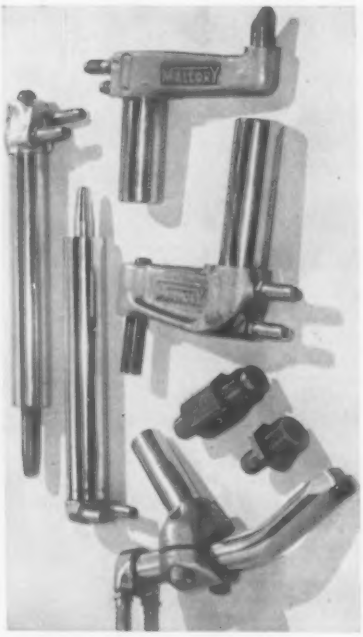
When there's *no second chance* to correct weld metal performance



WELD WITH ARCOS

STAINLESS BARE WIRE

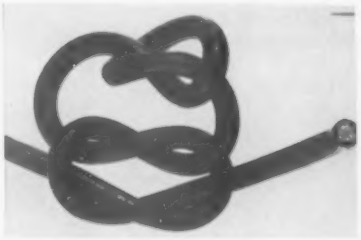
Even the critical countdown can't pre-test every vital factor before launching an earth satellite. Weld metal performance at diverse temperatures, various pressures and speeds can be known only through operation. Explorer I—America's first earth satellite—and Explorer III—designed and built at California Institute of Technology's Jet Propulsion Laboratory—both carry welds made with Arcos materials. Arcos CHROMENAR 12 (Type 410 stainless bare wire) was selected for welding certain components. Here's proof again why Arcos Welding Rods and Bare Electrodes are used so widely when results and performance must be predetermined as accurately as possible. ARCOS CORPORATION, 1500 South 50th Street, Philadelphia 43, Pa.



Welding holders

More than 1,000 separate combinations of resistance welding set-ups are possible with interchangeable components of new standardized resistance welding holders. Before, many of these combinations could be made only by specially designed holders. *P. R. Mallory & Co., Inc.*

Circle No. 36



Welding cable

Corona-resistant Neoprene jacketed welding cable, designed for use with high frequency welding, and a limp, flexible Neoprene jacketed whip lead increase production by reducing operator fatigue, firm says. All Neoprene compound used on cables is claimed to offer resistance to corona, oil, abrasion, heat, moisture, chemicals, crushing and impact. The jacketed cables come in sizes 4/0 thru 6, packed in 25, 50 and 100 ft boxes and on 250, 500 and 1,000 ft reels. The jacketed whip lead is stocked in sizes 1/0, and 1 and 2 on 250 ft reels. *Belden Mfg. Co.*

Circle No. 37

Liquid-nitrogen generator

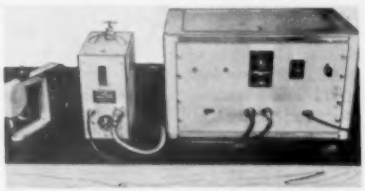
Generator is capable of producing liquid nitrogen from atmospheric air. Production rate is approximately four quarts of liquid nitrogen per hour. Installation requires 20 by 72 in. floor space. *Philips Electronics, Inc.*

Circle No. 38

Milling attachment

BLUE ribbon "Award of Merit" winner at the National Inventors' Congress Convention went to a new attachment for mounting on lathes, milling machines, etc. Precision work can be done on small or large parts with attachment. Requires little space, weighs 63 lb and includes ½ hp motor, pulleys, v-belt and draw bar. *Alva Allen Industries.*

Circle No. 39



Weld control

COMBINATION welding control unit is complete with portable pneumatically-operated welding hand gun. Unit consists of pneumatic portable weld head and air control unit used with spot and seam welding control unit. Weld head weighs 7 lb and can apply up to 75 lb weld pressure.

Unit provides both single spot and seam welding control, the latter with repetition rate of 1 to 20 spots per second. Also available with 60 spots per second rate. *Vacuum Tube Products Co., Inc.*

Circle No. 40

Paste solder

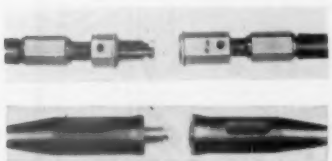
FIRM says new homogeneous paste type solder materials can boost present production rates in soldering and brazing operations. Eliminates separate application of flux and solder alloy and slow, expensive manual positioning of pre-formed wire shapes. *Fusion Engineering.*

Circle No. 41

Safety glasses

GLASSES have exclusive endpiece screw-guide for quick lens changing. Include five-barrel nickel steel hinges, choice of sideshields, plastic or stainless steel frame, spatula temples and a choice of hardened glass or optilite lens. *United States Safety Service Co.*

Circle No. 42

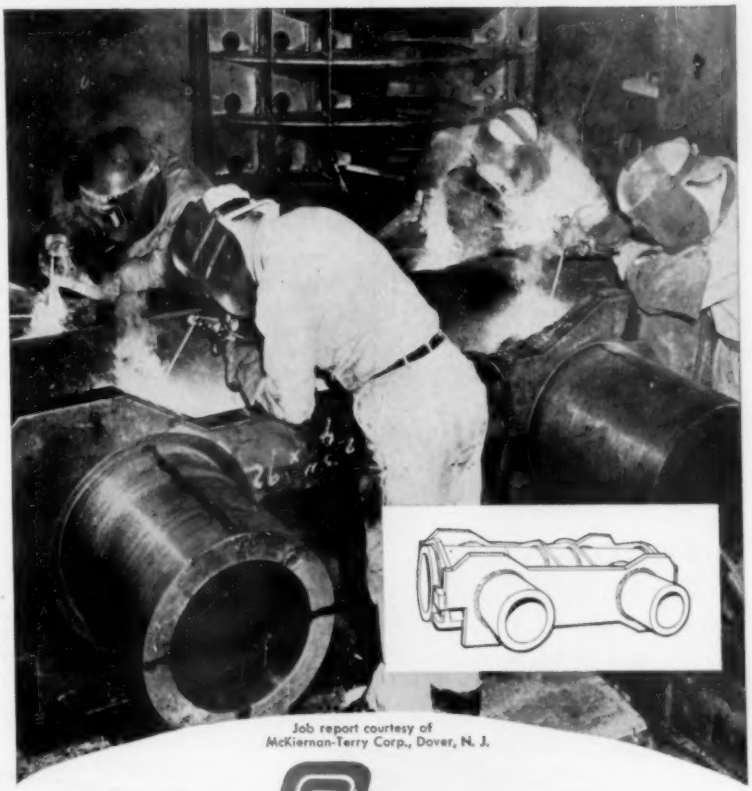


Cable connectors

ELECTRICALLY safe, crush-proof neoprene solder (Sol-Con) and mechanical connection (Mec-Con) cable connectors are now available. Male and female covers are identical and are tapered to fit snugly around the cable jacket to prevent snagging. One cover fits either half of both the solder or mechanical connection connectors. *Tweco Products Co.*

Circle No. 43

When low alloy weld requirements are as *critical* as these



Job report courtesy of McKiernan-Terry Corp., Dover, N. J.

WELD WITH ARCOS

LOW HYDROGEN ELECTRODES

This crosshead weldment—part of a Navy steam catapult for launching jet fighters—must withstand the repeated powerful surges of steam under high pressure. Arcos Tensilend 80 electrodes were used to weld the SAE 4130 low alloy steel. After progressive magnaflux checking, and proper stress relieving, all welds were found to meet the high strength and toughness required for this kind of service. For the *right* weld metal—for the *right* welding techniques—for your tough welding problems—call on Arcos. ARCOS CORPORATION, 1500 South 50th Street, Philadelphia 43, Pa.

SHOOT-A-LITE

SAFETY GAS LITER

The Practical Lighter for welding and cutting torches

SAFE! SURE! STRONG!

Ask your jobber or write us.

SHOOT-A-LITE CORPORATION

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New York 6, N. Y.

Neck flange

NEW ratings broaden range of firm's forged steel taper face welding neck flanges. Fatigue and bending tests under simultaneous pressure showed that flange should be recommended for 175 psi liquid, gas or air service at 150 F. Firm says it is suitable for 125 psi dry saturated stream at 353 F. Dimensions match cast iron flanges and valves having Class 125 flanges in accordance with ASA B16-1. *Tube Turns.*

Circle No. 44

Cooling unit

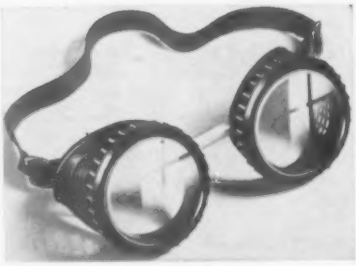
DUAL-purpose cooling unit can handle any two fluid cooling jobs in machine tool operation. Simple in design and operation, the "Dual unit" has one high efficiency refrigerating unit to handle the job. Each cooling circuit has separate controls. Shell and coil or counter-flow, double-tube systems are optional. Units are air-cooled. *Frostrode Div. of Warren Alloy*

Circle No. 45

Soldering flux

FORMULA for "585 super soldering flux," is said to increase capillary action and ease of soldering aluminum to dissimilar metals. Joints are free from porosity, manufacturer says. *Aladdin Rod & Flux Mfg. Co.*

Circle No. 46



Goggles

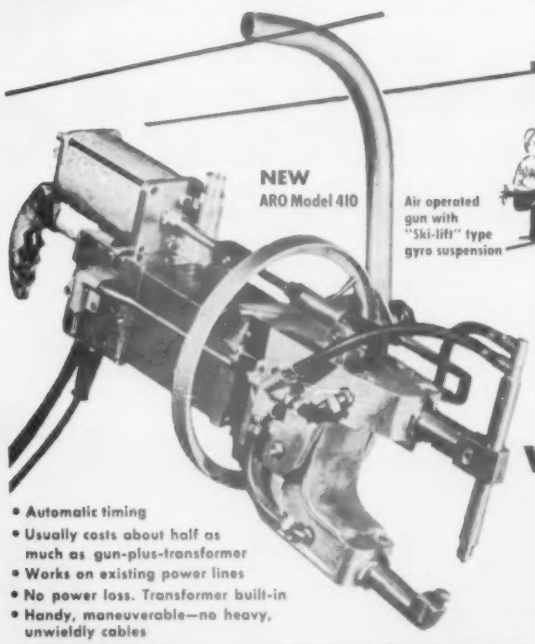
WELDING models of Econolite goggles are equipped with Baffl-Vents to protect eyes from flash rays. Other types are for grinding and chipping. Eye cups are plastic; deflecting louvers provide good ventilation yet keep out splash and flying particles. *Dockson Corp.*

Circle No. 47

Warning device

RADIOACTIVE isotopes used in industry, research and medicine are checked with new warning device called the "Gammalarm." It responds directly to radiation at a level as low as 3 mr per hour (1/100 of the recognized safe, permitted dose.) Whenever radiation exceeds safe level, lights flash, bells ring and all doors to working areas are locked. Alarm is lunch-box size and weighs 12 lb. It can be plugged into 115-volt a-c outlet. *Picker X-Ray Corp.*

Circle No. 48



ARO

Portable SPOT WELDERS with "SKI LIFT" type gyro suspension

- Automatic timing
- Usually costs about half as much as gun-plus-transformer
- Works on existing power lines
- No power loss. Transformer built-in
- Handy, maneuverable—no heavy, unwieldly cables

Illustrated Literature on Request

ARO SPOT WELDERS DIVISION OF GUTHERY MACHINE TOOL CORPORATION

38-31 CRESCENT STREET LONG ISLAND CITY 1, NEW YORK

Represented in Most Major Cities

Blasting machines

FIRM has added six portable blasting machines to line ranging from small blaster with 100 lb sand capacity to large machine with 1,200 lb tank capacity. Machines work from air compressor giving pressure from 30 psi to 120 psi. *Brennen, Bucci and Weber, Inc.*

Circle No. 49

Brazing alloy

BRAZING alloy does not require flux on copper to copper joints. Manufacturer claims joint brazed with No. 211 will prove stronger than the parent metal. Rod diameters range from 1/16 to ¼ in., melting point 1,300 F, brazing range 1,350 to 1,550 F, comparable analysis being 93% copper and 7% phosphorous. *American Brazing Alloys Co.*

Circle No. 50

Safety glasses

ONYX-on-crystal, spectacle-type safety glasses are di-electric, flame-resistant, strong and lightweight. Eyewire, which holds lens securely, is designed to support lens against being driven backward toward eye when struck. Lens groove is deep to accommodate safety lenses and supports entire periphery of lens—if severe impact breaks them, the fragments are held together. *American Optical Co.*

Circle No. 95

Silver brazing flux

DEVELOPED for silver, gold and platinum brazing, liquid flux is unique in that it can be applied with pipette, eye-dropper, hypodermic needle and metering devises, says maker. EutecLiquitor is designed for use in delicate instrumentation work that requires the joining of small wires, tubing and clasps. *Eutectic Welding Alloy Corp.*

Circle No. 96

Model 52 Multitron

"We Save More Than 50% of Radiography Costs on Welding Inspection by Using Nuclear Systems' Equipment"

This statement was made recently by Mr. J. C. Abbott, General Superintendent of Manufacturing at the Chattanooga, Tennessee plant of Combustion Engineering Inc., manufacturers of steam generating and related equipment, nuclear power systems and other products.

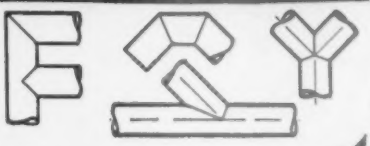
"In inspecting welding, we're using two Nuclear Systems gamma radiography machines 18 hours a day," continued Mr. Abbott. "Soon we'll have them in operation 24 hours a day at which time we expect to save up to 75% on radiography costs when compared with X-ray.

"In using X-ray we required expensive rigging to bring the work to the machine; now we simply move the easily portable Nuclear Systems machines around to our work locations."

Call on Nuclear Systems for your radiography equipment needs. Offices in Philadelphia, Chicago, San Francisco and Los Angeles. Sales representatives in principal cities. Catalog on request.

NUCLEAR SYSTEMS
A DIVISION OF THE BUDD COMPANY, Philadelphia 32
Budd

ANY Pipe Joint or Structural Angle Cut NOW Layed Out in Just MINUTES!



- Marks off easily and accurately any pipe joint.
- Eliminates all figuring of cut backs, and marks all around pipe.
- Saves man-hours, as well as oxygen and acetylene gas.
- Makes it easy to mark off end of lateral pipe.

NO MISTAKES — NO TIME LOSS

—regardless of the type or size of pipe joint to be welded. No more "cut and try" with a **CONTOUR MARKER** — it eliminates the need for calculation, and is available in 2 sizes for marking pipe and structurals of 1½" to 18" in cross section, and from 16" to 48" diameter. Send for complete description.

CONTOUR MARKER CORP.
1843 E. Compton Bl., Compton, Cal.
Also Mfgrs. of Boyce Centering Heads, Radius Markers and Pipe Flange Aligners.

THE CONTOUR MARKER

Welding bib

LEATHER bib fastens onto welding helmets. Of heavy brown cowhide, the bib is sized for full neck protection. It fits nearly all types of helmets. Three spring-type fasteners snap on the helmet. Weldor can open his jacket collar and first button while wearing bib. *John Tillman & Co.*
Circle 97

Ovens

ELECTRODE stabilizing oven features a 100 to 550 F temperature range. Cylindrical in shape, the "Dry Rod" oven provides protection against moisture damage to low hydrogen, stainless steel and other mineral-coated, special alloy electrodes. *Phoenix Products Co.*
Circle 98

Bender

VERTICAL ram-type bender is used for press bending. The machine bends to 180 deg, and can bend up to 2 in. heavyweight steel pipe. Coils, return bends, special curves, angle irons, channels, reinforcing bars, flat bars, etc., can be bent on the machine.

A motor-driven hydraulic pump mounted on an oil reservoir forms part of the machine's structural frame. *Wallace Supplies Mfg. Co.*
Circle 99

Tool chest

ALL-WELDED, 18-gage steel tool chest for storing equipment, tools and extra stock for job-site work is available in two sizes. "Weight is sufficient to discourage easy removal," manufacturer assures. An extended sloping top provides weather protection. *Scott-Rice Co.*
Circle 100

Cylinders

HEAVY-duty air and hydraulic cylinders, especially designed for automated equipment, can be used on welding machinery. The general purpose cylinders have pressure ratings of 200 psi (air) and 1,000 psi (hydraulic). In nine sizes and five mounting styles; flange (blind end), flange (rod end), clevis, adjustable trunnion and foot. Size range from 1½ to 8 in. bores, with strokes to specification. *The S-P Mfg. Corp.*
Circle 101

This on-the-job test reports:

"Cooler . . . lasts 3 times as long"

Spot Welder No. 89 | Service Welder No. 199 | Welder's Mitten No. 98

Riegel
WELDER'S GLOVES

"The Riegel No. 99 Heavy Welder lasts six weeks against two weeks for the glove we used formerly. The men tell us it's more comfortable and cooler."

So reports Mr. Richard Thornell, whose switch to Riegel now saves $35.00 yearly per man at Oliver Corporation, Springfield, Ohio.

No. 99 facts: Heavy but flexible "flextan" welders' leather, gunn cut, wing thumb. Extra roomy, extra long. One-piece back, wool-insulated . . . all exposed seams welted . . . full protection against heat and sparks.

Riegel has the service you want, too . . . industrial specialists to help select the right style . . . eight warehouses to speed delivery. Write or phone today.

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GLOVES THAT WEAR ON WHERE OTHERS WEAR OUT

Warehouses in:
Chicago • Conover, N. C.
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New York (Paterson, N. J.)
Oklahoma City
Portland, Ore.

Pure argon

PURITY of 99.995% is firm's claim for its argon gas. The new higher purity gas contains less than 50 parts per million of impurities. Delivered in liquid form, the argon even surpasses the 99.99% minimum purity. Gas has many industrial uses, including production of titanium, zirconium and other rare earth metals, and as an inert atmosphere for honeycomb panels for Mig and Tig welding. *Linde Co.*

Circle 102

Recording paper

PHOTO recording paper can provide instantaneous visible record of instrumentation test data. The photo-recording material may be used with several new, special-type moving mirror galvanometer oscillographs. It should find application for immediate read-out of test results in the missiles and aircraft field, etc. *Eastman Kodak Co.*

Circle 103

Bonding agent

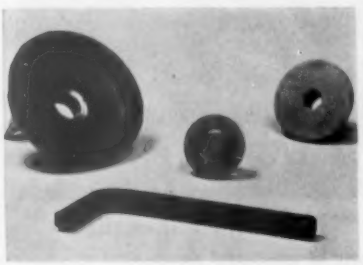
PRESSURE-bonding cement requires no priming, welding or heat-curing, firm states. Called "Nylosit 820," the new cement bonds nylon extrusions and moldings to nylon, and nylon to metal. Cements set at room temperature and are available in wide range of viscosities. *Ions Exchange and Chemical Corp.*

Circle 104

Rust preventive

METAL parts can be protected for two years or more during indoor storage with new water soluble rust preventive. A thin, transparent film is deposited which remains soft after the water evaporates. "Protect-O-Metal No. 299" is non-inflammable, non-toxic and practically odorless, manufacturer says. *C. W. Smith & Sons, Inc.*

Circle 105



NEW 4-in. disc support has been added to firm's line and is a companion support for 3-in. disc support. Items pictured are included in a disc support kit. *The Nedco Co.*

Circle 106

Typical Sonoweld applications, left to right: insulated copper wire to insulated copper wire, without stripping; aluminum foil to aluminum condenser can; aluminum foil conductor to stranded copper wire.

Ultrasonic Welding* without Fusion

SONOWELD®

This revolutionary new metal-joining technique uses high-frequency sonic energy to effect a solid-state metallurgical bond between similar or dissimilar metals without fusion and without formation of intermetallic compounds.

SONOWELD makes possible the welding of metals and shapes heretofore impossible to weld. Applicable to aluminum, copper, brass, zirconium, platinum, titanium, magnesium, carbon or stainless steel, gold, molybdenum, nickel, inconel, germanium, silicon, etc. Even the so-called exotic metals, such as tantalum, palladium, niobium, used in atomic energy applications, can be ultrasonically welded with SONOWELD.

With SONOWELD there is no spark or sputter to contaminate surrounding areas. Welding is accomplished at relatively low temperatures, with low clamping force and negligible external deformation. Joints are excellent.

Let us tell you more about SONOWELD — and how it may help you to better quality. Write us about your specific welding problems or application.

SONOBOND CORPORATION

A SUBSIDIARY OF AEROPROJECTS, INCORPORATED, WEST CHESTER, PA.

Manufacturers of Ultrasonic Metal-Joining Equipment

SONOWELD® • SONOBRAZE® • SONOSOLDER

**Ultrasonic Welding, originated and developed by Aeroprojects, Inc.*

NEW! WELSH FACE SAVER

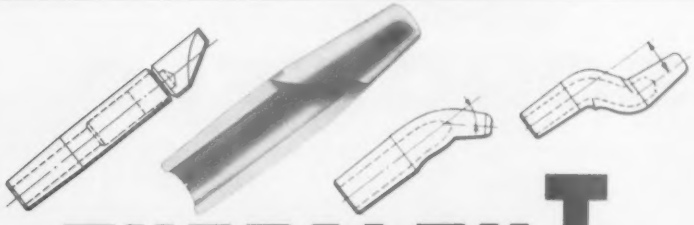
ONE SIZE COMFORTABLY FITS EVERYONE!

Another First!

New Welsh "TROJAN" Face Shield features rugged, lightweight, polyethylene headgear with simple ratchet adjustment with positive lock . . . and green or clear acetate windows held securely to wide fibre spark guard by fibre band with three positive snap fasteners.

WELSH Willingly Worn By Workers Everywhere

WELSH MANUFACTURING COMPANY
9 Magnolia Street, Providence, R. I.



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Resistance Welding Alloys

- **SPOTWELDING TIPS, a complete line** . . . R.W.M.A. Standard Tips, 'Tuffcap' Standard Tips, Cold-Formed Tips, Copper-Tungsten Faced Tips and many "Specials", all *carried in stock* in a wide selection of active types and sizes.
- **BAR STOCK,** round, hexagon, square and rectangular.
- **FORGINGS,** a large stock of bars and wheels available for finishing. Special forgings to order, rough, or finish-machined.
- **WELDING TIP HOLDERS and ADAPTERS**

You too may depend on *Tuffaloy,* with its record of over twenty years of prompt service and consistently high quality.

See your nearest AIRCO or TUFFALOY representative.

Ask for Catalog and Price List.

AIRCO®

AIR REDUCTION SALES COMPANY
A Division of Air Reduction Co., Inc.
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NEWS . . . . . *from page 8*

for the joining courses, but can be bypassed if one's experience warrants it.

Both the metal joining courses will be conducted by Isaac Goodman, metals joining engineer, Westinghouse Electric Corp., Bloomfield, N. J. All phases of joining will be covered.

Students will be encouraged in each course to present practical problems they have encountered in industry.

Oxygen producing plant built on Mesabi Range

A plant that will produce 65 tons of oxygen a day was built by the Linde Co. on the eastern end of the Mesabi Range to supply the mining pits at Minnesota's largest taconite plant with oxygen for its jet-piercing operations. The plant was built near the mine to overcome the large costs of the inherent down-time of any oxygen plant, the cost of installation, storage and transportation.

The plant consists of two phases designed to eliminate prohibitive costs. The first phase is the production of oxygen at the site of consumption. The second phase is Linde's Driox liquid system designed to back up the producing plant so that when a shut down occurs for any reason, or if a special demand requirement arises, the plant will be able to supply the open-pit mine with a continuous flow of oxygen.

Experimental engines

ONE of a series of experimental aluminum V-8 auto engines being lowered into test car. New engines weigh about 30% less than cast iron engine. Developed by General Motor's research and engineering staffs, the aluminum engines have undergone successful laboratory and road tests, the firm reports.

School proves value; B & D reap benefits

Because Frank Robinson, general foreman of the Hampstead, Md., Black and Decker plant, attended the customer grinding course offered by Norton Co., he increased the edge life of his firm's carbide boring tools by as much as ten times.

In a class session devoted to better tool grinding, Robinson learned the principle that a finer abrasive produces a stronger edge. Tool life can be increased by using a finer grit (220 or 320) diamond wheel for the finish grind on carbide tools. Returning to his home plant, Robinson decided that if a finer grit gave a better edge, he would try a very fine wheel. He assembled a special grinding attachment mounting a 1500S grit Norton diamond wheel, and results proved very good.

Union Carbide to build $4 million laboratory

Union Carbide Corp. has announced plans to build part of its planned $12,000,000 four-building project at East View, N. Y., and will start construction immediately on a $4,000,000 technical service laboratory. The new lab will be built on a 280-acre tract near East View, and will be ready for use by late 1959 or early 1960.

Carbide had originally planned to build four new buildings on the site, but postponed its plans in February.

The new building will have three stories, the main building having a total floor space of 85,000 ft. and accommodating 53 individual laboratory units. A 200-seat auditorium will also be part of the building.

Programs carried on at the lab will include the compilation and development of data on the pulp and paper, plastics, automotive, atomic energy and aviation industries.

TV show presents welding on the farm

Ned Nyberg, St. Louis welding consultant, recently demonstrated various ways welding and cutting can be used on the farm on TV show "Town and country," KMOX—TV, St. Louis.

Subjects covered by Nyberg included "Oxyacetylene welding, brazing and cutting," "Electric welding," "Identification of metals," "Maintenance and hardfacing."

St. Louis area welding suppliers furnished Nyberg with the equipment and operators needed for the shows.

NEVER AGAIN!-cut-fit-trim-refit-recut-refit

do it once — do it right!

with the

PAT. NO. 2408517

H & M SHAPE CUTTER

Accuracy in cutting or beveling saddles, tees, els, or other designs has long been a time-consuming, trial-and-error process in pipe fabricating. Today, however, you can produce *precise* cuts and bevels *the first time*—with an H&M Shape Cutting Attachment!

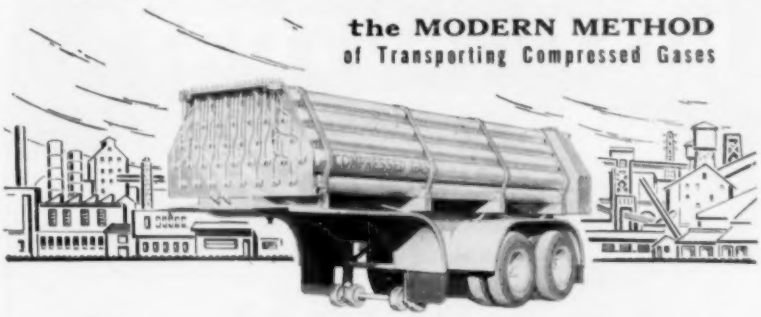
The H&M Shape Cutter is actually steered around the guiding template by exerting the proper spring tension on the sliding torch assembly. The cutting torch is thereby *forced* to reproduce the exact shape desired.

Eliminate those costly "re-cuts" and "re-fits" with an H&M Shape Cutter. Then—do it once, and you've done it right!

FULL DETAILS AVAILABLE IMMEDIATELY

H&M PIPE BEVELING MACHINE COMPANY
311 E. Third St. Diamond 3-0241
TULSA, OKLAHOMA

the MODERN METHOD of Transporting Compressed Gases



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- MANIFOLD & CONTROLS — for YOUR Gas and Handling Requirements
- CAPACITY — to meet YOUR Requirements
- SAFETY — Cylinders, Safety Devices, Controls etc., All in accordance with ICC Requirements for YOUR Protection.
- CHASSIS — by leading Chassis Manufacturers with Service Branches throughout the United States for YOUR Convenience.

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CYLINDERS AND GAS PRODUCING EQUIPMENT
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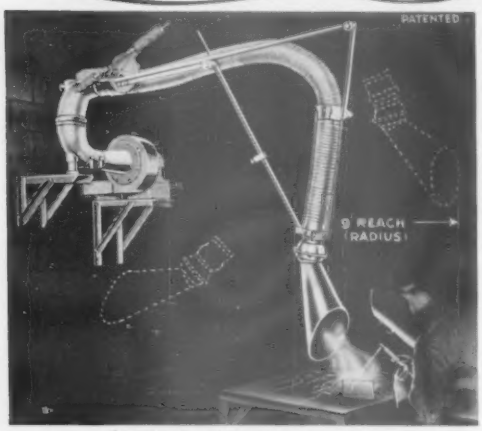
O'FALLON 5, ILLINOIS

"It certainly is a relief to have fumes and heat removed while I'm welding. The Ruemelin Collector has great suction. It makes a day's work pleasanter!"



Ruemelin Fume Collector in operation.

Welding shops equipped with Ruemelin Fume Collectors are assured of a clean shop atmosphere. Noxious fumes, heat and smoke are eliminated at their source, thus improving working conditions, lessening fatigue and paving the way for increased plant production.

The Ruemelin Fume Collector hood can be instantly placed where needed anywhere in the booth welding area. No tedious adjustments necessary. Just pull the inlet hood to the welding position and you are ready to go.

Note the new spring-loaded counterbalance mechanism which makes Fume Collector much easier to handle. Ask for Bulletin 37-E illustrating this new feature.

RUEMELIN MFG. CO.

MANUFACTURERS AND ENGINEERS
SAND BLAST AND DUST COLLECTING EQUIPMENT
3880 NORTH PALMER STREET • MILWAUKEE 12, WISCONSIN, U. S. A.

DISTRIBUTORS!

Looking for a Good Line?

Get the money-making facts *now* about ELMET Brand pure and thoriated welding electrodes, the top line in its field.

- *Attractive discount schedule*
- *Steadily growing demand*
- *An all-industries essential*
- *Ample stocks carried at all times*
- *Prompt shipment assured on all orders*

Old established firm in business since 1929.
Wire, phone or write

Elmet Division
North American Philips Company, Inc.
1558 Lisbon Road, Lewiston, Me.

Abrasive machine show attracts men, machines

The third annual national coated abrasive machinery show drew several thousand production men from all parts of the U.S. and from six foreign countries to view 150 new abrasive machines. The week-long show was sponsored by and held at Behr-Manning Co., Troy, N.Y., division of Norton Co.

Production men brought work pieces with them to test new machine's grinding and polishing performance.

Larger frames, bearings and drive trains were among significant advances in machine tool design. The addition of coolants to the work area, and to more thorough filtration of grinding swarf and other contaminants from the coolant flow was given much attention.

Featured were: a 150-hp grinder using a 50 in. wide abrasive belt for mechanical descaling and heavy removal; a 40-ft longitudinal polisher for tube, bar and extruded forms; and a centerless grinder with fully automatic gaging.

Philips gas liquefier earns gold medal

Philips Research Laboratories, Eindhoven, Netherlands, has been awarded the Kamerlingh Onnes Gold Medal for 1958. The award was given for developing a gas liquefier which is a source of liquid air or nitrogen for low temperature work in laboratories and industrial plants. The machine recondenses and separates gases, and produces temperatures down to —200 F. The Onnes medal is named for the first man to produce liquid helium at Leiden in 1908.

Stud welding firm starts Canadian plant

KSM Products, Inc., Merchantville, New Jersey, has established KSM of Canada, Ltd. in Toronto, Ontario. Sales manager for the new addition which will produce stud welding equipment, accessories and welding studs, is William Pennycook. Earl Wells is plant supervisor.

ASTM elects new president

Kenneth B. Woods, head, school of civil engineering, Purdue University, was elected president of the ASTM at the 61st annual meeting held in Boston, Mass., recently.

Metals Institute offers oxyacetylene welding course

Metals Engineering Institute, a division of American Society for Metals, Cleveland, Ohio, is offering a 15-lesson, illustrated course in oxyacetylene welding. The course, under the supervision of John H. Zimmerman, manager of gas processes for the Linde Co., includes study of production welding, inspection and hints on how to run a small welding operation. The course is open to individuals on a home study basis, and to employers for use in organized group study plans. For further information write: Metals Engineering Institute, 730 1R Euclid Ave., Cleveland 3, Ohio.

Adams Spot Welder changes owners

Tom Zilka, Portland, Ore., has recently purchased the Adams portable spot welder, which has been nationally distributed by welding equipment dealers since 1945. Zilka will keep the basic design of the unit, but will add to it an all-in-one control panel and six varieties of guns to be used with the unit.

Full-color movie shows aluminum welding

Reynolds Metals Co. Louisville, Ky., has produced a 33-minute sound movie that demonstrates simple and practical methods of welding aluminum. "Aluminum welding . . . different, not difficult," is available without charge for showing to business firms and other organizations.

Panhandle steel assets transferred to local firm

Assets totaling approximately one half million dollars were transferred from the American Petrofina, Inc., Abeline, Texas, holdings in Panhandle Steel Co., Wichita Falls, Texas, to a newly formed Wichita Falls corporation headed by Roger M. Tittle.

Ohio State expands Davis welding library

Ohio State University's Davis Welding Library has added a Facsi (fast access, coded small images) kit of references to its holdings. The kit contains coded, punched cards covering articles on non-destructive testing. The articles are reproduced in their entirety, in reduced form on one card, and read with a reading glass.

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Blast Metal Away with ARCAIR

Here's metal removal to beat anything you've ever seen before! Arcair Torch cuts, gouges, grooves, bevels or flushes off *any* metal . . . does it faster, cheaper, through a revolutionary combination of the electric arc and ordinary compressed air.

Inexpensive to install, economical to operate, easy to use —Arcair works with any standard arc welding machine.

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- Exclusive "Flo-Trol" diaphragm protects against back-fires; eliminates seat burn out.

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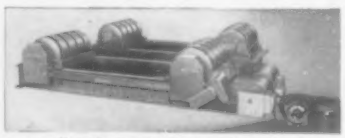
Offers You Over 200 PROVEN Standard Stock Models of Quality POSITIONERS "POSITIONEERED" to your exact Requirements

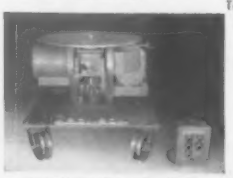
Aronson TracTred (T. M. Reg.) Turning Rolls for thin-walled heavy cylindrical work to 27 tons capacity. Zero to 100 IPM turning speed and Built-In Grounding.

Aronson Universal Balance Positioners (T. M. Reg.) position your weldments effectively, instantly for downhand welding. Capacities to 2000 lbs.

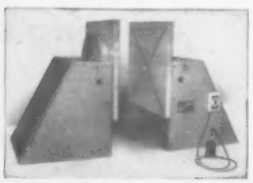


Heavy Duty Precision Built Rubber and Steel Tired Turning and Pipe Rolls, 100% overload protected. Capacities to 600 Tons.

Fully Automatic Gear Driven Positioners, featuring Geared Elevation, 135° Tilting and Variable or Constant Speed Rotation. Capacities to 350,000 lbs.



Model D Gear Driven Positioners. Compact. Precise. Rugged. Capacities to 1000 lbs.



Rugged Head and Tail Stock for positioning bulky weldments between centers. Table Backup for Zero Deflection, Magnetic Braking. Capacities to 160,000 lbs. Geared Elevation Optional.

Heavy Duty Floor Turntables with precision speed control and Magnetic Braking, used for welding, burning, X-raying, etc. Capacities to 120,000 lbs., various heights and speeds.

Bench Turntable Automatic Positioners with Mercury Grounding. Capacities to 500 lbs.

Quality POSITIONERS by **Aronson MACHINE COMPANY**
ARCADE, NEW YORK

Manuscript deadline nears in resistance welding contest

September 15, 1958 is the deadline for manuscripts on resistance welding in the contest conducted by the Resistance Welder Manufacturer's Association. Applications to enter the contest had to be in by July 1, and those who entered have until mid-September to complete and mail their papers.

Detroit firm gets inspection machine

A new mass spectrometer leak detector has been added to Wall Colmonoy Corp.'s brazed assembly inspection facilities at the Detroit plant. "We are now equipped to perform high tolerance leak detection functions for our customers," says R. L. Peaslee, division vice president and general manager.

The new equipment can exhaust parts down to below 1 micron pressure for vacuum testing with helium.

AWS president at *Independence* christening

G. O. Hoglund, president of the American Welding Society, and Fred L. Plummer, national secretary, attended the recent christening of the *Independence*, the fourth aircraft carrier in the *Forrestal* class. Over 3,000,000 lb of eletcrodes were needed to weld the carrier that is as high as a 10-story building, and has a flight deck of four acres.

Rensselaer probes welding ductile iron

A program of research in welding ductile iron was recently undertaken by Rensselaer Polytechnic Institute, Troy, N.Y., under contract to International Nickel Co. Conducting the investigations are Dr. Ernest F. Nippes, director of welding research, Dr. Warren F. Savage, supervisor of welding research, and associates in the Institute's department of metallurgical engineering.

Pipe Line News

The Federal Power Commission has accepted the Ohio Fuel Gas Co.'s application to abandon about 39 miles of pipeline, to be replaced by a proposed 51 miles of natural gas pipeline in Ohio. Construction is estimated at $2,163,000, and retiring the 39 miles will cost $91,000. (Salvage of retired sections should total about $109,000.)

Transcontinental Gas Pipe Line Corp., Houston, will build about 13 miles of lateral pipeline and a meter station at the South Duson Field in Lafayette Parish, La., to receive and transport natural gas to the firm's main transmission line. Cost will be $265,319.

Lone Star Gas Co., Dallas, has been authorized to construct and operate natural gas pipeline facilities during 1958 at a cost of $1,750,000. Lone Star will build various lateral pipelines, compressor stations and treating plants.

Natural Gas Pipeline Co. of America, Chicago, will build natural gas pipeline facilities at a cost of $86,158,000. The firm plans to build 232 miles of 36-in. loop line between Joliet, Ill. and Beatrice, Neb., (instead of 59 miles) about 258 miles of 36-in. and 21 miles of 26 in. loop line between Fritch, Tex., and Beatrice, (in lieu of 337 miles).

Trunkline Gas Co., Houston, has been authorized to build a pipeline crossing the Red River in Louisiana. Estimated to cost $1,750,000, it includes two 24-in. pipelines, each about 5,240 ft long, across the river at Rapides Parish, La.

Permission to build 13 miles of 20-in. natural gas pipeline was given New York State Natural Gas Corp., Pittsburgh. It will replace 12.9 miles of 12-in. line, at a cost of $923,900.

Radiation research expanded by Linde

Linde Co. has constructed a radiation laboratory on the grounds of its Tonawanda, N. Y., lab. The new lab has a cobalt 60 gamma ray source to study the effects of radiation on various industrial materials.

Researchers will be safeguarded by equipment that includes a 36 in. thick lead glass observation window and a set of manipulators called "master slaves." These are actually mechanical arms inside the cell that react to controls operated outside the observation window so operators can safely move objects within the radiation cell.

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Ideal for:

Plumbers
Refrigeration and air conditioning work
Electricians
Auto repair
Tile layers
Many others

Set is packed in handy metal carrying case. Note new compact pre-set LP-Gas regulator.

Provides economical heat for many jobs

Burns air and LP-Gas only . . . assures hottest, most efficient and economical flame possible with comparable equipment. Use for soldering, light brazing, general heating, etc. Features Slip-in tips that seat by hand; foolproof pre-set regulator; many accessories. Adapts easily for use with acetylene.

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1. It makes the strongest welds fastest.
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For the most effective and economical reclamation welding of parts worn through impact and abrasion.
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When a touch on a button moves weldments like these into the correct, most convenient position for a downhand pass, you get more arc time, more welding at lower cost. C-F power operated Positioners rotate the work in a full circle at any point in a range of 135° from the horizontal—giving welders a choice of an infinite number of downhand welding positions instantly.

Every requirement for faster, better positioned welding—constant or variable speed table rotation, full 135° tilt, self-locking gearing which holds the table in any position, oversize built-in main tilt, and rotating bearings, choice of two base styles, and many other features—are built into C-F Positioners.

C-F Positioners are available in Hand or Power operated models, and are made in capacities up to 30,000 lbs. and larger.

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AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT

COMING EVENTS

SEPT. 8-10: Canadian Section, Compressed Gas Association meeting, Seigniory Club, Montebello, P.Q., Canada.

SEPT. 18: NEMA Arc Welding Section Quarterly Meeting, Cleveland.

SEPT. 25-26: NWSA Eastern Zone Meeting, Benjamin Franklin Hotel, Philadelphia.

SEPT. 29-30: NWSA Central Zone Meeting, Morrison Hotel, Chicago.

OCT. 20-24: National Safety Congress and Exposition, Hotels Conrad Hilton, Congress, Morrison, La Salle, and Hamilton, Chicago.

OCT. 27-28: NWSA West Central Zone Meeting, Hotel Muehlebach, Kansas City, Mo.

OCT. 27-31: 1958 National Metal Exposition and Congress, Cleveland Public Auditorium, Cleveland.

OCT. 30-31: NWSA Western Zone Meeting, Riviera Hotel, Las Vegas.

DEC. 1-2: NWSA Southeastern Zone Meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala.

DEC. 4: NWSA Southwestern Zone Meeting, The Statler Hilton, Dallas, Tex.

DEC. 4: NEMA Arc Welding Section Quarterly Meeting, Chicago.

JAN. 26-29: Plant Maintenance and Engineering Show, Cleveland Public Auditorium, Cleveland.

MARCH 12, 1959: NEMA Arc Welding Section Quarterly Meeting, Pittsburgh.

MARCH 16-20, 1959: ASM Western Metal Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles.

APRIL 7-10: 1959 AWS Welding Show, International Amphitheatre, Chicago, Ill.

JUNE 4-5, 1959: NEMA Arc Welding Section Quarterly Meeting, Hot Springs, Va.

Tube Turns makes titanium fittings

A complete line of welding fittings and flanges of commercially pure grades of titanium to match every schedule and size of titanium piping made is being manufactured by Tube Turns, a division of National Cylinder Gas Co., Chicago.

Distributor appointments

Aronson Machine Co., Arcade, New York: Airline Welding and Engineering Co., Hawthorne, Calif.; Texas Welding Supply Co., Dallas, Texas; Arcet Equipment Co., Richmond, Va.; Dye Oxygen Co., Inc., Phoenix, Ariz.; Kirk-Wiklund Co., Kansas City, Mo.; R. and R. Welding Supply Co., Des Moines, Iowa.

Alloy Rods Co., York, Pa.; Lacey Automotive Parts Co., Salinas, Calif.; Engle Welding Supply Co., Des Moines, Iowa.

About people . . .

Frank S. Briggs has been named manager of Tube Turns' new nuclear energy and power plant section of the sales development department, Louisville, Ky. Since 1955 he has specialized in application of welding fittings and flanges of piping systems of atomic reactors and modern electric power plants.

Roger R. Giler is new product planning specialist for Westinghouse Electric Corp.'s welding division, Buffalo. He is a member of the American Society for Metals and the American Vacuum Society, and has written papers on vacuum metallurgy.

Daniel F. Jones is the first assistant manager of Johnson Mfg. Co., Inc., Mt. Vernon, Ia. The newly created position entails handling sales and engineering services for the firm's line of solder and fluxes.

Dr. Bernard Kopelman is new director of market development for Sylvania-Corning Nuclear Corp. He will develop new products, as well as new markets for current products.

Major General *Clayton C. Jerome*, USMC, will join Budd Co. as director of industry development, headquartering in Budd's Los Angeles office. Jerome served in WW II and Korea, and has been director of Public Information, Recruiting and Marine history while in the service.

Robert E. King has been appointed distribution equipment sales manager of the Square D Co. and will headquarter in Detroit. Distribution equipment division produces circuit breakers, switchboards, lighting panels and related equipment.

Jerome

King

Taylor

Perkins

Harris Calorific Co., Cleveland, recently announced four personnel changes: *Stevenson H. Taylor*, formerly in charge of staff productions, is now executive vice president. *Leigh H. Perkins*, former sales manager, is new vice president in charge of sales and *Roy L. Rasmussen*, assistant sales manager, is now sales manager. *Richard M. Peck*, plant superintendent, has been named works manager.

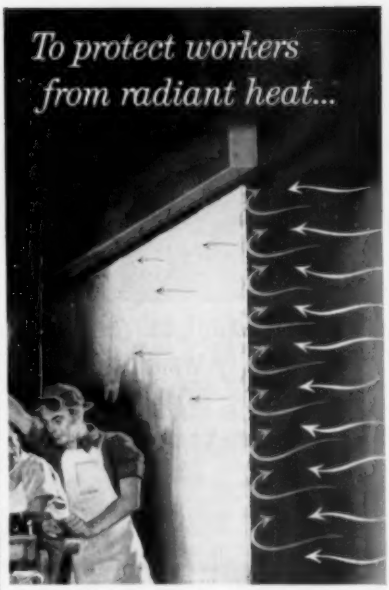
National Cylinder Gas Div. has appointed *Otto H. Wilhelm* manager of the Columbus district; *A. D. Fischer* manager of McKees Rocks, Pa., district; and *Charles H. Diment*, manager of the Cincinnati district. The company has oxygen and nitrogen plants in each of the three headquarter cities, and acetylene plants in Columbus and McKees Rocks.

James H. Bly has been named assistant sales manager in charge of domestic sales at High Voltage Engineering Corp., Burlington, Mass. He formerly supervised engineering activities related to X-ray generators in industrial radiographs.

Denison Engineering Div., American Brake Shoe Co., Columbus, Ohio, recently announced the following appointments: *Robert F. Norris*, plant manager, Delaware, Ohio; *Carl W. Lindahl*, works manager, Columbus; *George T. Hays*, director of purchasing.

Fred C. Stockinger has been transferred to the home office of Bay State Abrasive Products Co., Westboro, Mass., to assume the new position of assistant sales manager for the company's grinding wheel sales organization. *Robert F. Kelleher* will replace Stockinger as west coast district manager.

Frederick F. Wood has been elected assistant to the vice president, publicity and advertising, of International Nickel Co. of Canada, Ltd., and assistant vice president of the company's U.S. subsidiary, The International Nickel Co., Inc., New York City.



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Radiant heat is a major cause of discomfort and fatigue that reduces efficiency and causes accidents. Economical new J-M *Aluminized* Asbestos Cloth reflects 90% of all radiant heat . . . helps maintain high production and good safety practices.

This new J-M material is a rigidly tested combination of aluminum and Asbestos. It retains a great degree of strength at temperatures up to 1400°F —over long periods of time—and can be used for curtains, shields, blankets, hoods and covers to protect workers from flame as well as radiant heat.

For further data, write Johns-Manville, Box 14, New York 16, N. Y. Ask for Brochure TX-2A.

PORTABLE SHIELDS for emergency jobs near heat or flame can also be made with this J-M *Aluminized* Asbestos Cloth.

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100 YEARS OF QUALITY PRODUCTS . . . 1858—1958

Get the exact current for quality welding!

USE THE TONG-TEST AC-DC AMMETER

Don't assume your welders are using the right amperage. *Be certain* by controlling welding quality with the Columbia Tong Test AC-DC Ammeter, the only clamp-type instrument that measures both alternating and direct current. Snap tongs around the electrode cable for instant readings. Available in five types with interchangeable ranges up to 1000 amperes. Impossible to read wrong scale. No coils or wires to burn out—no electrical connections needed.

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ORNAMENTAL IRON CASTINGS

MORE THAN 400 DESIGNS for making up ornamental iron grille work, columns, rails. A design for every style of architecture. Complete range of standard sizes.

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Please send 32-page catalog: "Everything for the Ornamental Iron Shop."

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*Company*_____

*Address*_____

*City*_____ *State*_____

Forty-year old American Welding & Mfg. Co. recently re-organized operating and sales personnel at its plants in Warren and Niles, Ohio. *Frank J. Shanaberg* will become manager of sales for the Industrial Div. plant in Warren. He replaces *M. R. Minnick*, vice president-sales, who has resigned. *George E. Stalle* has been named general manager of the Building Products Div., Niles, and *James R. Doran* was chosen field sales manager.

Al Trail, who has headed the Rochester, N. Y., office of Vickers, Inc., has been promoted to district sales manager of the firm's Cleveland office.

Knowles B. Smith, executive vice president of Dix Engineering Co., Inc., Lincoln Park, Mich., has been elected president of the Metco System Contractors, a technical and trade organization.

Gene Wedereit has been named director of advertising and public relations for Chemetron Corp., Chicago.

The newly-created post of eastern region sales manager for Tube Turns, Louisville, Ky., will be filled by *Jack D. Tolliver*, manager of the sales development department. Tolliver will be replaced by *Edward F. Harrington*, and will headquarter in Louisville.

Newly-appointed general sales manager of Magnethermic Corp., Youngstown, Ohio, is *James K. McLaughlin*. Assistant general sales manager will be *Peter A. Hassell*.

Oxygen specialist *Kurt Kuhlmann* is new general plants superintendent of Industrial Air Products Co., Portland, Ore. He replaces *Levon Josephanin*.

George E. Kennedy has been named branch manager of Nelson Stud Welding Div., Gregory Industries, Inc., Lorain, Ohio. He will serve the seven-state Chicago territory. *George A. Medsker* has been appointed Cleveland branch manager.

Lincoln Electric Co., Cleveland, Ohio, has announced the appointment of the following three district managers: *John F. Kotchian*, North Haven, Conn., office; *Charles M. Richardson*, Franklin, Pa., office; *William F. Fischer*, Phoenix, Ariz., office.

John Kmet is the new plant superintendent for the General Split Corp., Milwaukee.

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FOR ALL HEAT-DEPENDENT OPERATIONS . . .

looks like a crayon
marks like a crayon
tells temperatures like a precision instrument

Sixty-three different compositions enable you to determine and control working temperatures from 113° to 2000°F. TEMPILSTIK® marks on workpiece "say when" by melting at stated temperatures — plus or minus 1%.

Also available in liquid and pellet form . . . Write **Welding Sales Dept.** for sample TEMPIL® pellets . . . State temperatures of interest — please!

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EISLER VERTICAL TYPE PRESS WELDERS

We also make a complete line of Spot and Wire Butt Welders.

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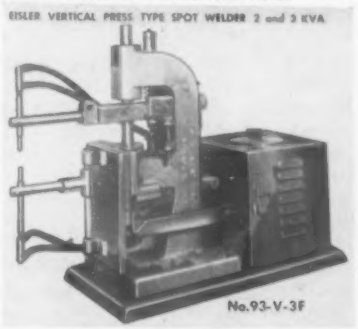

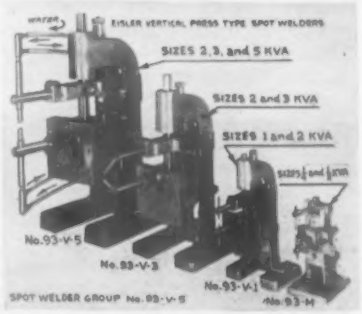

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Choose the one best suited to your needs and order by number. All ANTI-BORAX Products guaranteed. Send for circular and free sample.

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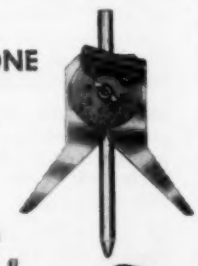
Really FIVE TOOLS in ONE



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- The Protractor
- The Centerhead
- The Center Punch
- The Level
- The Scale

Determines Center Line at any Degree and Measures Degree of Declivity

DIAL SET LEVEL

Weighs only 9 ozs. Pocket size.

Y type head accurately machined with tangents and tips for centering and aligning. Dial Set Level in graduations of 2½ and 10 degree markings. Punch of Drill Rod with hardened point—insuring long service. Send for complete description.

CONTOUR MARKER CORP.
1843 E. Compton Bl., Compton, Cal.
Also Mfgs. of Contour Markers, Radius Markers and Pipe Flange Aligners.

BOYCE CENTERING HEAD

30 YEARS AGO

(Taken from the *Welding Engineer* of August, 1928)

Underwater cutting played an important part in the construction of the new Hudson River bridge, New York City. Steel pile cofferdams were constructed within which the concrete piers were built. Upon completion of the job, the cofferdams projected above the water level presenting an unsightly appearance. About 900 steel sheet piles were cut off 50 ft below the low water level, leaving the rest of the steel wall to protect against underscouring by the river current. It took two divers four weeks to complete the job, averaging 15 piles each a day.

—30 YEARS AGO—

John B. Tinnon has been appointed sales manager of the Thermit Dept. of Metal and Thermit Corp.

—30 YEARS AGO—

Press brake construction has been simplified and improved since the Cincinnati Shaper Co., Cincinnati, started to build brakes of welded steel plates. Welded plates eliminate the use of massive steel or iron castings, and solve the problem of breakage caused by heavy duty and overloading that cast brakes were subject to. Evidence that the new welded brakes have solved the breakage problem is in the growing popularity of this type construction.

—30 YEARS AGO—

Much experience was gained in the construction of the arc-welded steel factory building of the West Philadelphia works of General Electric Co. Considered were: The competency of weldors, type and strength of weld needed when designing, cleanliness of steel to be welded, and shop welding as many pieces as possible to avoid field welding.

—30 YEARS AGO—

An editorial proposed that good welding is usually economical welding. It cites the case of weldors who were trying to hurry through a job on a high pressure gas pipe line, and turned out below standard welds. When a rule was instituted to limit the number of welds to be completed each day, the result was better welds and a lower cost per weld due to less gas and more skill being used.

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has been FIRST with every important advancement made in

ELECTRODE HOLDERS

Brilliant Red Tips and Trigger—Bright Yellow Handle — all Glass Fibre, an outstanding safety feature!

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No Other Product Can Do a Galvanizing Job Like

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Does - *HERE'S PROOF*

Heat welded seam on galvanized sheet to 600° with Torch

Rub GALVALLOY against heated surface as shown — now spread with wire brush for a bright finish.

GALVALLOY Covers the Same Amount of Area with 1/5 the Amount of Material.

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free literature . . . . . USE CARD OPPOSITE

51. GENERATOR—Hobart Brothers Co. Folder DM-74 details 400-cycle induction heating generator, tells how simplifies preheating and stress relieving of arc welded joints.

52. WELDER—Ergolyte Mfg. Co. Model 131 a-c welder for small shop garage or maintenance department covered on catalog page. Includes specifications, advantages.

53. CHEMETRON STORY—Chemetron Corp. Attractive new brochure describes activities of firm, formerly the National Cylinder Gas Co. Includes products and services of company's seven divisions, subsidiaries and affiliate companies.

54. ELECTRIC HOISTS—American Chain & Cable Co., Inc. Eight-page bulletin DH-133D contains data on construction, weights, dimensions, etc., of electric hoists.

55. SOLENOID VALVES—Atkomatic Valve Co., Inc. Catalog 200-A describes types of valves and application; includes flow charts and price lists.

56. SOLENOID VALVES—Automatic Switch Co. Brochure illustrates valves for primary and secondary system in pressurized water reactors. Includes specifications and application data.

57. WELD WIRE—Page Steel and Wire Div. Comparison chart DH-1218-M covers gas welding rods, bare electrodes, automatic welding wire and metal spray wire.

58. FILMS—DuPont Co. Booklet A-1009a describes types of films, exposure ranges, processing and calibration, plus a bibliography on Dosimeter film usage.

59. SALT BATH FURNACE—Ajax Electric Co. Catalog 117 covers furnaces, includes conventional and latest models. Technical data includes ustempering and martempering curves.

60. FLAME HARDENING—Detroit Flame Hardening Co. Includes chart with range for hardness and depth usually required in rolls; sizes and kinds of rolls flame-hardened for steel industry.

61. TELEVISION EQUIPMENT—General Precision Laboratory. "How many jobs" shows types of cameras, control units, monitors, accessories and projection systems and their varied applications.

62. MANGANESE STEEL—Manganese Steel Forge Co. Booklet describes broad applications for ductile, wear-resistant non-magnetic, rolled and forged manganese steel.

63. RESIN COATINGS—Alpha-Molykote Corp. Bulletin 115 includes instructions for degreasing all metals; phosphating stainless steels; applying lubricant coating by spraying or dipping and required baking times.

64. RECTIFIER—International Rectifier Corp. Bi-monthly publication covers all aspects of rectifiers and latest research.

65. CARBON ARC—Hobart Brothers Co. Bulletin DM-72 tells how large foundry reduced cleaning room costs with carbon arc-compressed air cutting equipment.

66. RECEIVING TUBES—General Electric. Interchangeability chart ETI-1572 lists characteristics of tubes they can replace; gives specifications and base diagrams of all types pin connections.

67. PVC LININGS—Kayko- Industries, Inc. Handbook covers three types polyvinyl chloride lining for corrosion protection, includes table comparing resistance of conventional and unplasticized linings to acids and salts.

68. ZIRCONIUM, HAFNIUM—Mallory-Sharon Metals Corp. Steps in production and processing plus description of properties and corrosion resistance data.

69. ALLOYS—Cerro de Pasco Sales Corp. Lists applications of alloys in metal working field, gives descriptions and properties.

70. RETOOLING—Olin Mathieson Chemical Corp. Examples of process designers can use to reduce retooling time and costs by using single sheet of metal.

71. X-RAY ANALYSIS—North American Philips Co. Covers principles of operation and application and uses diagrams to illustrate differences between film diffraction, diffractometry and spectography.

72. PLATE COIL—Dean Products, Inc. Bulletin number 355 discusses specifications, features and application of new type heating and cooling coil.

73. GAS MANIFOLDS—Air Reduction Sales Co. Catalog 829 contains information on cylinder capacity, arrangements and dimensions and describes advantages of manifolding.

74. SHAPE CUTTING—Heath Engineering Co. Booklet describes oxygen-flame shape cutting machines—advantages, applications and specifications. Includes pictures, diagrams and WELDING ENGINEER data sheets.

75. COMPOSITE METAL—Chicago Bridge and Iron Co. Describes manufacture of composite metal which provides continuous bond between alloy or special metal and backing plate.

76. PRECISION MEASURING—Griswold Mfg. Co. Mounting requirements and directions for operation included in pamphlet on measuring instrument.

77. POWDER-LANCING—Linde Co. Booklet 1164 gives history of powder-lancing and how process is used in steel and construction industries. Case histories cited.

78. HOSE—Raybestos-Manhattan, Inc. Data on construction, service, sizes, pressures, weights and fittings for following types industrial rubber hose: M610 air, M620 water, M630 steam, M640 water suction, M650 petroleum, M660 Ind. fire, M670 spray and welding, M680 special service.

79. GAGES—W. C. Dillon & Co., Inc. Specifications, dimensions and capacities of scientific testing instruments used to measure pressure, tensile or torque.

80. BRAZING ALLOYS, FLUXES—United Wire and Supply Corp. Schedule B-50 lists standard prices for low temperature brazing alloys and fluxes.

81. CABLE TERMINATION—Erico Products, Inc. Discusses features of Cadweld lugs, making lugs from copper bar, etc. Includes charts and pictures.

82. ATOMIC FORUM—Atomic Industrial Forum, Inc. Papers available from recent forum cover metallurgy and metals fabrication.

83. VACUUM HOSE—Flexible Tubing Corp. Describes uses and features of new vacuum cleaner hose for industry. Includes pictures and chart.

84. WELDING FITTINGS—Babcock and Wilcox Co. Bulletin FB-503 explains proper ways to prepare requisition or order for welding fittings and flanges

85. ELECTRODES—Ampco Metal, Inc. First quarter 1958 issue of *Ampco Welding News* contains applications on use of aluminum bronze electrodes and filler rod.

86. STAINLESS STEEL—Wall Colmonoy Corp. Engineering data sheet uses graph and pictures to explain properties and applications of stainless steel brazing alloy.

87. ALUMINA CERAMIC—Diamonite Products Mfg. Co. File folder of alumina ceramic standard and special products contains information on physical properties and characteristics.

88. NOTCHING TOOL—Vogel Tool and Die Corp. Folder describes tube and pipe notching machines, hand power punch presses and cut-off machines.

89. STEEL CASTING—Steel Founders Society of America. Revised edition of "Fundamentals of steel casting design" features data from SFSA research.

90. SOLDER—Federated Metals. Sheet explaining RTS activated rosin core solder and its advantages.

91. GAMMA IRRADIATION—Atomic Energy of Canada Ltd. Folder and diagram of gamma irradiation cell explains mechanism and maintenance and dose rate variation.

92. BERYLLIUM—The Beryllium Corp. 12-page booklet on industrial hygiene aspects of beryllium metal, oxide, alloys is called "Plain talk on beryllium."

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THE WELDING SHOPPER

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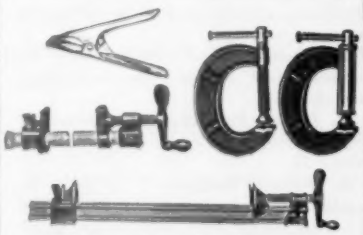

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"the clamp folks"

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Traveling District Sales Manager, resident of San Francisco area, to sell and service distributors and customers in Northern California for leading producer of reclamation welding products for the repair of equipment subject to impact and abrasion. Welding experience desirable. Write Box 824, C/O Welding Engineer, 5826 Dempster St., Morton Grove, Ill.

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Welding or Metallurgical Engineer is required for Welding and Brazing research. Should have at least a B.S. degree and several years of experience.

This is a permanent position on the expanding staff of a midwestern industrial research organization. This is a challenging assignment offering optimum opportunity for professional growth, stimulating staff associations and an unusually pleasant working climate. Receive excellent salary and employee benefits.

Write Box No. 825, C/O Welding Engineer, 5826 Dempster St., Morton Grove, Ill.

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Steel and Alloy Plate Fabricator

Wants Personnel experienced in Pressure Vessel and Tank Work, background in Shop Management with experience in all procedures, methods and organization. Plant near St. Louis has growth situation for Superintendent and Engineer.

Write Box No. 826, c/o Welding Engineer 5826 Dempster Street, Morton Grove, Ill.

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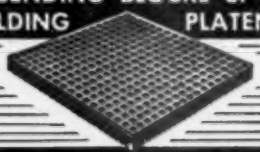

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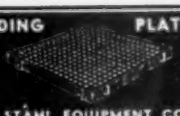

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CUTTING MACHINES, AIRCO Camo & Radiagraphs and NATIONAL No. 5.
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SPOT WELDER, National, 40 KVA, Used.
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HEAVY DUTY TURNING ROLLS

for rotating pressure vessels, pipe and cylindrical bodies for welding

Aronson MACHINE CO., ARCADE, N. Y.

A COMPLETE LINE of WELDING POSITIONERS

SCHOOL

WELDING—A profitable trade. Demand for trained men. Learn quickly at best equipped school in U. S. Non-profit. G. I. approved. Catalog free. Write: Hobart Welding School, Box U-881, Troy, Ohio.

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LATE TYPE WELDING POSITIONERS FOR SALE

16,000 lb. Cullen-Friestedt Model 140, 54" x 54" table, motorized tilt and rotate, new 1943.

16,000 lb. Worthington Model 6H, 53" x 53" table, headstock type, motorized rotate, non-tilt, new 1952.

6,000 lb. Cullen-Friestedt Model 60, 40" x 40" table, variable motorized rotate and constant tilt, new 1944.

3,000 lb. Cullen-Friestedt and Ransome, variable motorized rotate and constant tilt, new 1943. (4 in stock.)

ESTES MACHINERY COMPANY

114 So. Clinton St., Chicago 6, Ill.

Phone—DEarborn 2-6595

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Bigger-Better—NEW

. . . the 2nd edition is just off the press. Get your copy now . . .

This cross-indexed volume contains 126 of the best Data Sheets appearing in WELDING ENGINEER in the past 15 years. Yet it costs only $1.40!

See your welding supply distributor or order from:

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This advertisers' index is included as a convenience and is in no way a part of the advertising contract. Although every care has been taken to index accurately, some errors may have occurred and no allowance will be made for them.

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125. Adjustable Clamp Co.—Write for catalog on complete line of "Jorgensen" and "Pony" clamps.

126. Aeroprojects, Inc.—Further information available on ultrasonic welding without fusion.

127. Air Reduction Sales Co.—Information on power sources for welding.

128. Air Reduction Sales Co.—Catalog 1318 "Airco Electrode Guide" will help you select the right electrode for your specific job.

129. Alloy Rods Co.—For a complete set of data sheets write for Bulletin AR-8-2 on "Atom-Arc" iron powder low hydrogen electrodes.

130. All-State Welding Alloys Co., Inc.—Information available on aluminum welding wire; also data sheets.

131. Aluminum Co. of America—Write for booklets and films that show how easy it is to weld, braze and solder aluminum.

132. American Manganese Steel Div.—Write for technical data on hardfacing with "Amsco 20."

133. Ansco X-Ray—If you are actively engaged in industrial X-ray work, send for a copy of "Radioisotopes In Industry."

134. Anti-Borax Compound Co.—Sample and circular on cast iron No. 1 welding flux.

135. Arcair Co.—Further information available on Arcairs metal removal torches.

136. Aronson Machine Co.—Detailed engineering data available on Aronson's positioners.

137. Aro Spot Welder Div.—Illustrated literature on the new model 410 portable spot welder with "Ski Lift" type gyro suspension.

138. Atlas Welding Accessories Inc.—Further information available on the Atlas line of weld cleaning tools and the new "Jaw Cleaner."

139. Becker Brothers Carbon Co.—Catalog available giving complete specifications and scaled drawings of carbon welder brushes.

140. Budd Co.—Catalog available on Nuclear Systems radiography equipment.

141. Cam-Lok Div.—Write for catalog No. 131-B on the complete Cam-Lok line of neoprene insulated Cable Connectors, Splices and Machine Receptacles.

142. Columbia Electric Mfg. Co.—Illustrated catalog on tong-test ac/dc ammeter.

143. Contour Marker Corp.—Details on establishing and marking a point at any angle.

144. Contour Marker Corp.—Information and instruction book on laying out pipe joints.

145. Cullen-Friestedt Co.—Positioner catalog available on low cost welding.

146. Dockson Corp.—Write for catalog on Head and Eye Safety Equipment and distributor's name.

147. Drawalloy Corp.—Bulletin 355 DC provides complete information on every grade of Drawalloy welding wire.

148. Eastman Kodak Co.—Further information available on Kodak Industrial X-ray film, type AA.

149. Eisler Engineering Co.—Catalog No. 93-57 gives complete information on Eisler's spot and wire butt welders and the vertical type press welder.

150. Erico Products, Inc.—Further information available on "Caddy Ground Clamp M-2233."

151. Eutectic Welding Alloys Corp.—Welding Data Book gives procedures and theory of welding practices on all metals.

152. Federal Machine and Welder Co.—Further information available on Federal's "Warco Packaged Production Lines" automated production from material to product.

153. Fibre-Metal Products Co.—Write for further information on "SuperLite" aluminum safety cap and other safety equipment.

154. General Electric Co.—Further information on the new portable x-ray "LX-140" is available.

155. H & M Pipe Beveling Machine Co.—Write for information on the H & M Shape Cutter.

156. Harnischfeger Corp.—Bulletin "HF Welders" available on P & H welders for inert-gas welding.

157. Harnischfeger Corp.—Write for bulletin "R-29" on low-hydrogen iron-powder electrodes.

158. Harris Calorific Co.—Further details available on the Gaugeless regulator Model 77.

159. Hobart Brothers Co.—Write for further information on Hobart's new ADI-364-S arc welder and a welder's vest pocket guide.

160. Independent Engineering Co.—Further information available on transporting gases by gas supply trailers.

161. International Nickel Co., Inc.—Booklet giving full technical data entitled "Inco Welding Products" is available.

162. International Nickel Co., Inc.—Booklet, "Now You Can Weld Dissimilar Alloys Easily" gives case histories on problem welds.

163. Jackson Products—Further information available on Jackson's Unigoggle.

164. Johns Manville Corp.—Brochure TX-2A explains the J-M "Aluminized Asbestos Cloth."

165. Lenco Inc.—Further information available on "Hi-Amp" electrode holders.

166. Lincoln Electric Co.—Write for bulletin 7000.1 new Weldirectory of Lincoln mild steel electrodes.

167. Linde Co.—Further information on the "Heliarc HW-18" hand welding torch, and where you can examine and try it.

168. Linde Co.—Write for information on "Oxweld" No. 25 M Flux-Coated Bronze Rod.

202. Linde Co.—Catalog F-4487 explains the "Oxweld" portable cutting machines.

169. Liquid Carbonic—Details on "Liquidweld" torches and "Do-It-Yourself" kits.

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WELDING INFO-AIDS

USE THIS CARD for Literature, Catalogs, and Bulletins shown on preceding pages and for those featured in this month's ads as listed opposite and on following page

Also information about

NEW PRODUCTS described on pages 70 to 83

Every month WELDING ENGINEER lists many new catalogs and bulletins available from manufacturers. All are yours for the asking. However, this service is valuable to you only if you use it.

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★ For copies of any manufacturers' bulletins described on these pages, circle the number of the items on card at right. Fill in your name, title, company and address. This has to be done only once on either post card. You need no postage.

★ For additional information on New Products described in this issue, circle the numbers of the items that interest you. The New Products section begins on page 70.

WARNING!

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Morton Grove, Ill.

Literature offered in ads

(Continued from page 96)

170. Magnaflux Corp.—Write for information on the Magnaflux 4-Point Test Program.

171. Maitlen & Benson Inc.—Further information on "Wypo" cutting and welding tip cleaners.

172. Merrill Brothers—Information on lifting clamps, twin and drum lifters, drum tilters and other material-handling devices.

173. Metal & Thermit Corp.—For reference material prepared to aid you in your stainless welding operations, write for the "Murex Stainless Fact File."

174. Metalloy Products Co.—Testing samples of "Galvalloy" available for your galvanizing job.

175. Miller Electric Mfg. Co. Inc.—Complete particulars on Miller welders and the new "Lectro Spot" welder.

176. National Carbide Co.—Information on calcium carbide available, also name of nearest distributor.

177. National Cylinder Gas—Bulletin N-142 describes the new NCG Electronic Line Tracer.

178. National Welding Equipment Co.—Brochure No. 4 is available on National's welding equipment.

179. Norris-Thermador Corp. — Write for specifications on all sizes of Norris-Thermador's acetylene cylinders.

180. North American Philips Co.—Write if interested in distributorship of Elmet brand welding electrodes.

181. Norton Co.—Write for Form 1748, a catalog on Norton reinforced wheels.

182. Page Steel and Wire Div.—Write for Welding Wire Comparison Chart DH-1218, Submerged arc and inert gas welding wire Folder DH-402A and gas welding rod Booklet DH-1277.

183. Picker X-Ray Corp.—Further information available on the new "Andrex" portable x-ray unit.

184. J. C. Renfroe & Sons, Inc.—Catalog on complete line of lifting clamps available.

185. Riegel Textile Corp.—Write for further information on Riegel weldor's gloves.

186. Ruemelin Mfg. Co.—Bulletin 37-E explains how to keep plant air clear of welding fumes.

187. Scientific Electric Co.—Write if interested in free demonstration of the induction heater.

188. Shawinigan Products Corp.—Information on calcium carbide and name of nearest distributor.

189. Shoot-A-Lite Corp.—Literature on "Safety Gas Liter" for welding and cutting torches.

190. Smith Welding Equipment Corp.—Further information available on the "Big 98" welding and cutting outfit.

191. Smith Welding Equipment Corp.—Write for more information on the "Handi-Heet" air LP-gas soldering torch kit.

192. Stoody Co.—Write for further information on Stoody's hard-facing equipment.

193. Stulz-Sickles Co.—Details available on "Manganal" bare welding electrodes and name of nearest distributor.

194. Tempil Corp.—Information and sample pellets of temperature indicators; state temperature desired.

195. Tennessee Fabricating Co.—Write for catalog "Everything for the Ornamental Iron Shop."

196. Tuffaloy Dept., Air Reduction Sales Co.—Catalog and prices available on Tuffaloy spot welding tips, welding tip holders and adapters.

197. Tweco Products, Inc.—Information on Tweco's laminated glass cloth insulation with melamine resin.

198. Victor Equipment Co.—Write for further information on Victor's cutting torches and tips.

199. Victor Equipment Co.—Victor Hardfacing Manual available, also dealerships.

200. Welsh Mfg. Co.—Further information available on the new "Trojan" face shield.

201. Westinghouse Electric Corp.—Data available on the Westinghouse Thyratron tubes.

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TWECO'S laminated glass cloth insulation with melamine resin

IT WILL NOT BREAK
IT WILL NOT BURN
IT WILL NOT CARBON CHAR

and only TWECOTONG® has it!

Tip insulators on your electrode holders take an awful beating. Searing arc heat causes most materials to carbonize quickly and conduct current, destroying their insulating value. Slam-bang handling and dropping soon cracks and shatters brittle insulation. Only SUPER-MEL has proved its ability to stand up in tough arc welding service. This fireproof insulation is built up of many layers of strong, woven glass cloth, laminated and bonded together under great pressure with pure melamine resin. It will never char or carbonize. It will remain sound for month after month, in spite of hard service and abuse. Standardize on SUPER-MEL . . . exclusively yours on TWECOTONG electrode holders.

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Tweco

MANUFACTURERS: ARC WELDING ELECTRODE HOLDERS, GROUND CLAMPS, CABLE CONNECTORS, TWECO-LITE ALUMINUM WELDING CABLE

PRODUCTS, INC.

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No rewelding possible...

Job for Inco-Weld "A"... the electrode that handles most problem joints...

and welds most dissimilar alloys, too

This weldor is fabricating a 12-foot high stainless steel reaction vessel designed to operate at more than 1200°F.

Insulating jacket prevents weld repairs...

In service, this vessel is entirely covered by an insulating jacket. Permanent welds are a must to prevent lengthy delays for repairs.

The root pass was made with a stainless steel electrode matching that of the vessel. But then the problem started. Toronto Coppersmithing engineers wanted to avoid heat treating the vessel after welding to remove weld brittleness. The welds had to be strong enough to withstand 1200°F. and be unusually ductile.

Inco-Weld "A" Electrode produces strong, sound, ductile welds

After a series of tests, they found Inco-Weld "A"* Electrode could be depended upon to produce the high quality welds needed without special procedures. What's more, the deposits made with this electrode have a coefficient of expansion close to that of the stainless steel – an important advantage when operating temperatures soar to 1200°F!

What's your joining problem?

Try a few tests with versatile Inco-Weld "A"† Electrode, the electrode with the distinctive green flux, for welding dissimilar alloy combinations, or Inco-Weld "A" Wire – the new inert-gas metal-arc wire just introduced. Both produce high quality welds between ferritic and austenitic stainless steel, low alloy and mild steel, high nickel and other alloys.

Get this new booklet

"Now You Can Weld Dissimilar Alloys Easily" includes case histories on problem welds solved and results on test data compiled on dissimilar alloy combinations. Send for your copy.

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†Formerly sold as Inco-Rod "A"* Electrode.

THE INTERNATIONAL NICKEL COMPANY, INC.

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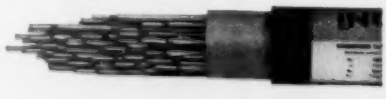
INCO WELDING PRODUCTS

electrodes • wires • fluxes